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ABSTRACT

The purpose of this curriculum guide is to help teachers implement the Alabama Course of Study: Science. The major emphasis of the guide is to provide student-oriented, hands-on activities that engage students in "sciencing" behaviors. This guide has two major components, the table of contents and the activities. The table of contents lists by Roman numeral the units covered in grade 5. Each unit is organized into topics that describe further the content of the grade level. The smallest organizers in the table of contents are the student outcomes that describe in detail what students are expected to learn about each topic. After each outcome, a page number directs the reader to a classroom activity (or activities) that addresses the specific outcome. The second and largest component of the guide consists of classroom activities. Each activity begins with identifiers that summarize and introduce the activities. The identifiers are the Unit, Topic, and Outcome(s) addressed by the activity. Each activity contains a background section that provides teachers with information they may need to teach the activity effectively. Following the background, all materials needed for the activity are listed in a section entitled "Materials." Procedures for implementing the activity are outlined next. In some cases, extensions of an activity or source for an activity appear after the section on procedures. Units include the following: (1) "Organisms"; (2) "Growth and Maintenance"; (3) "Weather"; (4) "Oceanography"; (5) "The Land and Its Resources"; (6) "Space"; (7) "Matter and Energy"; (8) "Sound and Energy"; (9) "Production, Consumption, and Conservation of Energy"; and (10) "Contributions and Careers in Science." (KR)

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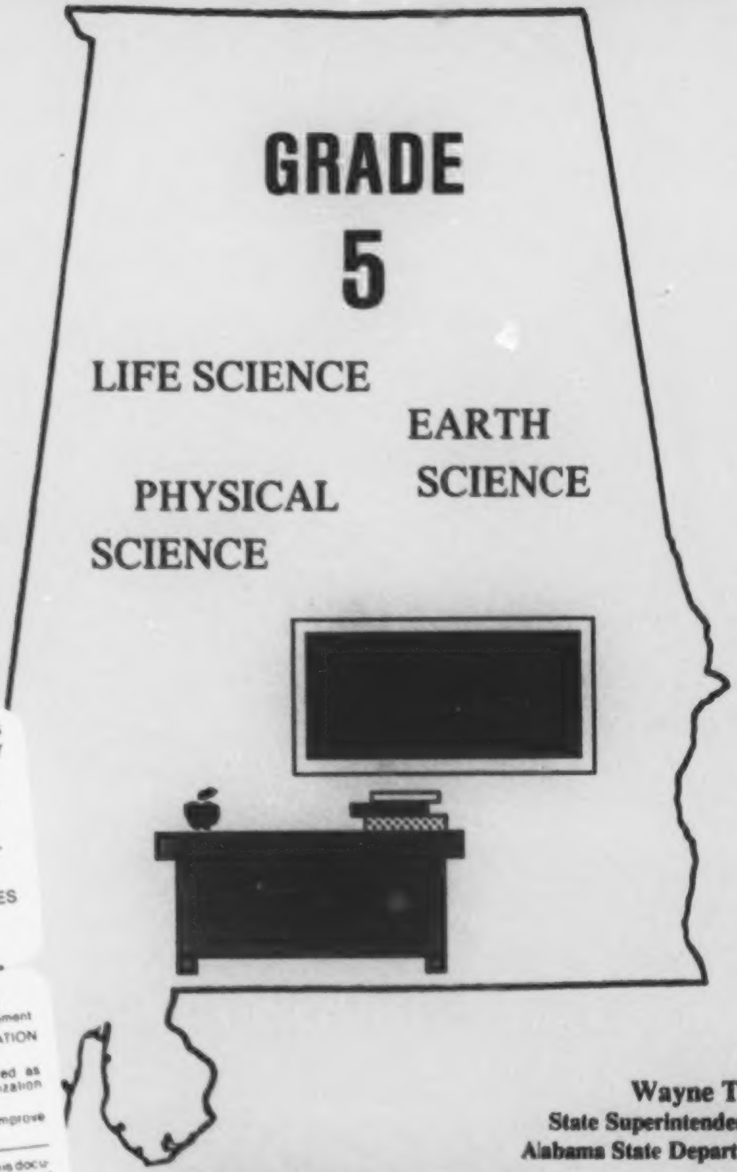
SCIENCE

CURRICULUM GUIDE



GRADE

5

LIFE SCIENCE

EARTH
SCIENCE

PHYSICAL
SCIENCE

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Alabama State Department of Education

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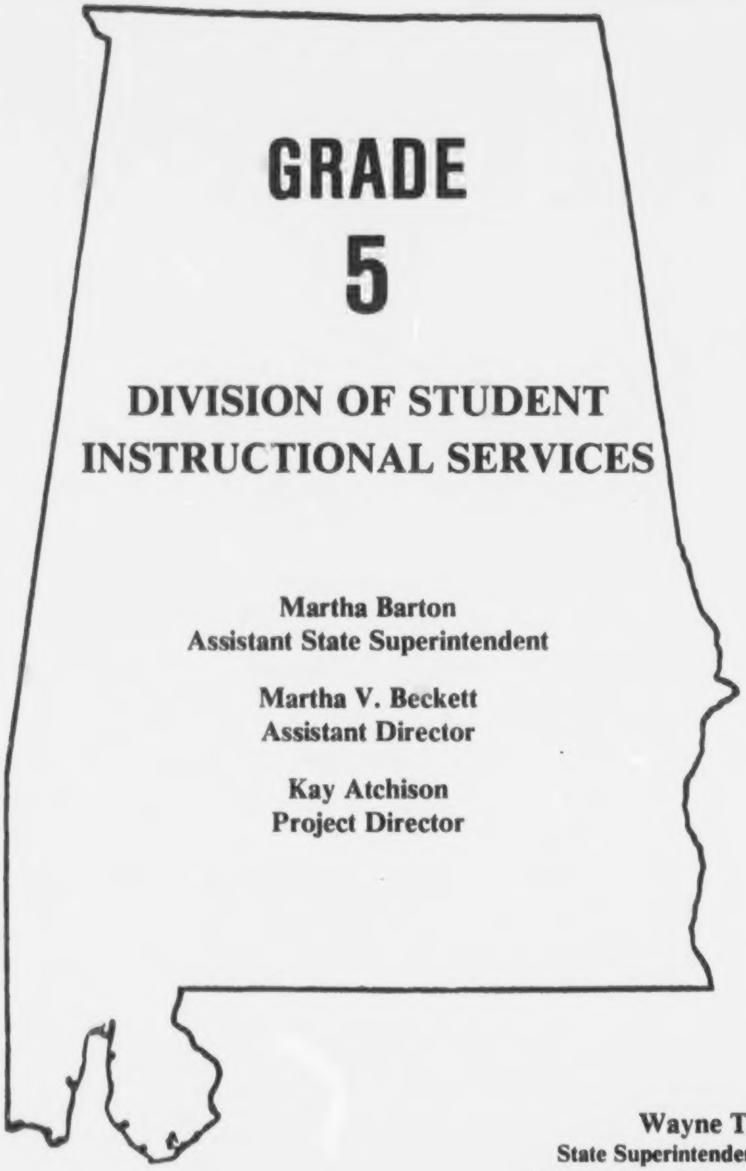

GRADE
5

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Bulletin 1989, No. 75

INTRODUCTION

The science curriculum guides consist of nine documents, one for each grade kindergarten through grade eight. The purpose of these curriculum guides is to help classroom teachers implement the Alabama Course of Study: Science (Bulletin 1988, No. 35). The major emphasis of each guide is to provide student-oriented, hands-on activities that engage students in "sciencing" behaviors.

The science curriculum guides have two major components, the Table of Contents and the activities. Each guide begins with the Table of Contents that lists by Roman numerals the units covered at a grade level. Each unit is organized into topics that describe further the content of the grade level. The smallest organizers in the Table of Contents are the student outcomes that describe in detail what students are expected to learn about each topic. After each outcome, a page number(s) directs the reader to a classroom activity (or activities) that addresses the specific outcome.

The second and largest component of the guide consists of classroom activities. Each activity begins with identifiers that summarize and introduce the activities. These identifiers are the Unit, Topic, and Outcome(s) addressed by the activity. Each activity contains a Background that provides teachers with information they may need to teach the activity effectively. Following the Background, all materials needed for the activity are listed in a section entitled Materials. Procedures for implementing the activity are outlined next. In some cases, extensions of an activity or sources for an activity appear after the Procedures.

The science curriculum guides are supplemental in nature. They were created to complement and enrich locally-developed science curriculum plans and to provide instructional resources for all topics named in the Alabama Course of Study: Science. Consequently, each activity in the curriculum guide stands alone and does not need to be taught in the order in which it appears in the document. It is expected that local education agencies will sequence the activities in this guide to correspond with the order in which topics are outlined in their locally developed scope and sequence for science.

ACKNOWLEDGEMENTS

From its inception, the development of curriculum guides has been viewed as a cooperative effort between specialists in the Division of Student Instructional Services and selected teachers from public schools in Alabama. While the Curriculum Development Section, under the leadership of Katherine Mitchell, had the responsibility for coordinating the project, approximately 75 educators contributed directly to the science curriculum guides.

Work on the science curriculum guides started in the fall of 1988 when Kay Atchison was selected as Project Director for grades K-6 and Donna Bentley was named Project Director for grades 7 and 8. The second phase of the project involved the recruitment and training of approximately 35 classroom teachers and university instructors who wrote activities for the guides. For six months (December 1988 through May 1989) writers created activities to address specific outcomes, and the State Department of Education staff typed, edited, and proofread numerous drafts of the activities.

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GRADE 5
TABLE OF CONTENTS

Page

I. ORGANISMS

Topic: Classification of Organisms

Outcome 1 - State reasons why scientists classify organisms systematically by their characteristics...............11

Outcome 2 - Classify animals into major categories of vertebrates and invertebrates by their characteristics...............17

Outcome 3 - Classify plants into four phyla by their characteristics...............21

Outcome 4 - Identify types of fungi by characteristics...............23

Outcome 5 - Identify major groups of bacteria and viruses..........25

Outcome 6 - Identify basic groups of protozoans....................28

Topic: Cells, Tissues, and Organs

Outcome 7 - Identify differences between plant and animal cells........31

Outcome 8 - Compare different types of cells and their functions.....31

Outcome 9 - Describe the relationship between cells and tissues.....35

Outcome 10 - Compare the functions of different types of tissue.....41

Outcome 11 - Describe the relationship between tissues and organs....45

Outcome 12 - Describe the relationship between organs and organ systems......................50

Outcome 13 - Compare the functions of different types of organs and organ systems.............50

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Topic: Interdependence of Organisms

Outcome 14 - State reasons why many plants and animals have become extinct and others are endangered....................54

Outcome 15 - Identify possible ways to protect plants and animals from extinction or endangerment..................54

Outcome 16 - Discover how plants and animals adapt to environmental conditions......57

II. GROWTH AND MAINTENANCE

Topic: Life Cycles

Outcome 17 - Compare the life cycles of plants and animals...........59

Topic: Need for Food and Oxygen

Outcome 18 - Explain why living things must have food and oxygen to survive....................66

Outcome 19 - Explain how green plants make food..........................74

Outcome 20 - Explore the role of green plants in the production of oxygen........................76

Topic: Digestive System

Outcome 21 - Discuss organs of the digestive system and how they work together............80

Outcome 22 - Discuss digestion and effects of enzymes on food..........................85

Outcome 23 - Explain the processes of diffusion and osmosis.........87

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Outcome 24 - Explain that digested food is utilized in each cell.........90

Topic: Circulatory System

Outcome 25 - Discuss organs of the circulatory system and how they work together............95

Outcome 26 - Explain the function of blood..........................95

Outcome 27 - Discuss components of blood and the function of each......102

III. WEATHER

Topic: Weather Factors

Outcome 28 - Describe ways heat energy, water movement and air movement affect weather.......106

Outcome 29 - Define the weather terms lows, highs, fronts, and precipitation.................112

Outcome 30 - Explain how changes in ocean currents affect weather.......115

Topic: Effects of Weather

Outcome 31 - Explain the effects that weather has on plans for recreational activities or travel........................118

Outcome 32 - Explain how weather determines cost or availability of food..122

Outcome 33 - Explain how prewarning forecasts save lives and property when tornadoes, hurricanes, floods, or freezing occur................122

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Outcome 34 - Explain results in the loss of lives and damage to property caused by hurricanes, tornadoes, or other weather phenomena.......126

Outcome 35 - Explain how pollutants at low levels in the air cause heat inversions to occur...........129

Topic: Controlling Weather

Outcome 36 - Explain how rainmaking chemicals are used in an effort to control weather.......................132

Outcome 37 - Explain how arid areas of the world are made habitable......134

Topic: Seasonal Changes

Outcome 38 - Explain how plants and animals have adapted to seasonal changes.......................136

IV. OCEANOGRAPHY

Topic: Importance to People

Outcome 39 - Compare the percentage of the earth's surface that is covered with water to the percentage that is dry land.........................139

Outcome 40 - Discuss the importance of the ocean in our lives...........141, 145

Topic: Life in the Ocean

Outcome 41 - Explain how salinity, temperature,depth, and light affect amounts and kinds of life in the ocean..........148

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Topic: Underwater Exploration

Outcome 42 - Describe geological formations and features found on the ocean floor....153, 157

Outcome 43 - Describe special types of equipment necessary for underwater exploration....157, 162

V. THE LAND AND ITS RESOURCES

Topic: Layers of Earth

Outcome 44 - Describe three layers that compose the earth....169

Outcome 45 - Identify common materials that contain matter from the earth's crust....170

Topic: Physical Features

Outcome 46 - Explain how external forces can cause changes in the earth's crust....172

Topic: Rocks

Outcome 47 - Describe properties of rocks....174

Topic: Minerals

Outcome 48 - Explain that natural elements or compounds in the earth's crust are minerals....177

Outcome 49 - Identify minerals by testing their properties....177

Topic: Conservation

Outcome 50 - Explain why some minerals are in short supply and what should be done to conserve them....177

Outcome 51 - Explain why topsoil must be preserved....182

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Outcome 52 - Discuss methods of conserving soil and water................182

VI. SPACE

Topic: Components of the Solar System

Outcome 53 - Explain the components of the solar system: the sun, planets and their satelites, meteors, comets,and asteroids.....................185

Outcome 54 - Explain that the sun is the center of the solar system and the planets revolve and rotate in orbit around it............................189

Outcome 55 - Explain the difference between refracting and reflecting telescopes.........192

Outcome 56 - Calculate the distance between the moon and the earth........196

Outcome 57 - Discuss light years as units of measure for distances between objects in the solar system and beyond.............200

Topic: Relationships Between the Moon and the Tid

Outcome 58 - Describe the phases of the moon.........................203

Outcome 59 - Explain how the phases of the moon the tides are related.......................206

Outcome 60 - Explain how the surface of the moon has been shaped by volcanic activity, gravity, and meteors..................214

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Topic: Exploration

Outcome 61 - Discuss problems associated with acceleration, weightlessness, radiation, deceleration, and distance in space travel..............216

Outcome 62 - Investigate the benefits of space exploration to mankind......................220

VII. MATTER AND ENERGY

Topic: States of Matter

Outcome 63 - Discover effects of heat or cold on molecules of matter.......................223

Outcome 64 - Discover the effect of heat on water........................226

Topic: Structure of Matter

Outcome 65 - Discover that matter is composed of small particles called molecules..............228

Outcome 66- Discover the effects of heat or cold on molecules of matter.......................229, 232

Outcome 67 - Discover that molecules are composed of particles called atoms........................235, 237

Topic: Elements, Compounds, and Mixtures

Outcome 68 - Explain the composition of elements, compounds, and mixtures.....................242

Topic: Physical and Chemical Changes

Outcome 69 - Explain a physical change in matter.......................246

Outcome 70 - Demonstrate a chemical change in matter....................248, 251

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Outcome 71 - Compare a physical change and a chemical change in matter...252, 256

VIII. SOUND AND ENERGY

Topic: Production and Characteristics of Sound

Outcome 72 - Explain how sound is produced...258

Outcome 73 - Describe characteristics of sound: pitch, volume, and timbre........................266

Outcome 74 - Explain the uses of sound energy........................269

Topic: Speech Organs

Outcome 75 - Explain functions of lungs, larynx, lips, tongue, and teeth.........................271

Topic: Sense of Hearing

Outcome 76 - Describe parts of the ear and their functions in hearing....273

Outcome 77 - Explain ways of protecting the sense of hearing..............277

Outcome 78 - Infer what would result if the sense of hearing were lost....280

IX. PRODUCTION, CONSUMPTION, AND CONSERVATION OF ENERGY

Topic: Newton's Third Law

Outcome 79 - Explain Newton's Third Law......282

Topic: Electrical and Mechanical Energy

Outcome 80 - Explain a simple electrical circuit.......................284

Outcome 81 - Discover the uses of electrical energy.............286, 288

Outcome 82 - Discover uses of mechanical energy.......................294

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Outcome 83 - Identify an example of electrical energy changed to mechanical energy.............295

Topic: Magnetism

Outcome 84 - Explore uses of magnets.........297

Outcome 85 - Explain how a magnet works......300

Outcome 86 - Discover the difference between bar magnets and electromagnets................302

Topic: Heat Energy

Outcome 87 - Explain heat energy.............304

Outcome 88 - Identify materials that are conductors and nonconductors of energy.....................307

Outcome 89 - Discover substances which do and do not conduct heat.......310

X. CONTRIBUTIONS AND CAREERS IN SCIENCE

Topic: Contributions of Scientists

Outcome 90 - Identify men and women who have contributed to the fields of Life Science, Earth Science, and Physical Sciences.............312

Outcome 91 - Describe what men and women have done in the fields of Life Science, Earth Science, and Physical Science..........312

Outcome 92 - Explain why an understanding of the Life Sciences, Earth Sciences, and Physical Sciences can contribute to the quality of life in today's and tomorrow's societies....................312

GRADE 5
TABLE OF CONTENTS
(Continued)

Page

Topic: Career Opportunities

Outcome 93 - Identify careers related to an understanding of the Life Sciences, Earth Sciences, and Physical Sciences.........312

Outcome 94 - Explain how careers depend on a basic understanding of the Life Sciences, Earth Sciences,and Physical Sciences......................312

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Classification of Organisms
OUTCOME: 1. State reasons why scientists systematically classify organisms by their characteristics.

Background

Scientists classify all living organisms into groups based upon their similarities and differences. Classification means to put items into groups. Classifying organisms makes it easier for one to study about them. Scientists name each species of plants and animals according to its classification. Since a scientific name is made of two words, the genus name and the species name, a scientist can describe a certain animal and another scientist can understand the classification.

Classification is useful to scientists in other ways, also. It allows scientists to state how they think living things are related. When scientists wish to discover information about humans, they may do the research not with humans, but with monkeys or other mammals that have body structures similar to humans. Medicines, for example, are tested on animals before they are tested on humans.

This activity is designed to aid students in discovering reasons why scientists classify organisms through the development of simple classifications systems. Seed packets for the activity may be purchased at a garden supply store. The activity will require one class period of forty-five minutes to an hour.

Materials

For each group:
- Ruler, metric
- Variety of mixed seeds in packets
- White paper, blank
- Handout: DEVELOPING A CLASSIFICATION SYSTEM
- Shoes, several pairs

Procedures

1. Introduce the concept of classification. Ask volunteers to place a shoe in a pile in the middle of the floor. Sort the shoes into two piles.

OUTCOME 1 (Continued)
Procedures (Continued)

2. Explain that certain traits or features are used to do the sorting. Invite students to guess which traits are being used. As soon as someone guesses correctly, allow students to sort shoes into two groups using another feature. (Possible features may include right and left shoes, colors on the shoes, high-top and low-top, or running and non-running.)

3. Following this introduction, lead a discussion about what is meant by classification. Include in the discussion the importance of classification to scientists as they attempt to name and study all of the living organisms in the world.

4. Explain that in the next step of the lesson, students will work in pairs to develop a classification system.

5. Assign partners and distribute materials to each pair of students. (Review mm and cm markings on the metric ruler at this time, if necessary.)

6. Instruct pairs of students to read the directions on their worksheets and proceed with the activity.

7. Monitor groups as they work to assist if necessary.

8. If some groups finish the activity early, have them exchange seed packets and worksheets with another group and compare answers.

9. When all pairs have completed their worksheets, discuss answers to questions 6, 7, and 8.

DEVELOPING A CLASSIFICATION SYSTEM
Handout

In this activity you will work with a partner to develop a classification system and to discover ways that systematic classifications of organisms assist scientists.

DIRECTIONS

1. Empty seed packet onto blank sheet of paper.
2. Examine seeds carefully.
3. Record the characteristics of the seeds on the chart.
4. Use the information on the chart to develop a classification system for seeds.
5. Put seeds into groups according to your classification system.

SEEDS	LENGTH	WIDTH	COLOR	SHAPE	TEXTURE	WEIGHT

DEVELOPING A CLASSIFICATION SYSTEM
Handout (Continued)

Now that you have classified your seeds, see if you can answer these questions:

6. How would your classification system help you give your seeds a name?

7. How could your system of grouping help you discuss certain seeds with a classmate?

8. Based on what you have learned, name two ways that classifications of organisms could be useful to scientists.

DEVELOPING A CLASSIFICATION SYSTEM
Key

In this activity you will work with a partner to develop a classification system and to discover ways that systematic classifications of organisms assist scientists.

DIRECTIONS

1. Empty seed packet onto blank sheet of paper.
2. Examine seeds carefully.
3. Record the characteristics of the seeds on the chart.
4. Use the information on the chart to develop a classification system for seeds.
5. Put seeds into groups according to your classification system.

SEEDS	LENGTH	WIDTH	COLOR	SHAPE	TEXTURE	WEIGHT
#1	6 mm	2 mm	gold	round	smooth	very light
#2	11 mm	3 mm	black	oval	smooth	heavy

DEVELOPING A CLASSIFICATION SYSTEM
Key (Continued)

Now that you have classified your seeds, see if you can answer these questions:

6. How would your classification system help you give your seeds a name?

   (They could be named according to color, shape, size, or texture.)

7. How could your system of grouping help you discuss certain seeds with a classmate?

   (My classmate would know to which group of seeds I was referring.)

8. Based on what you have learned, name two ways that classifications of organisms could be useful to scientists?

   (Naming and studying)

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Classification of Organisms
OUTCOME: 2. Classify animals into major categories of vertebrates and invertebrates by their characteristics.

Background

The animal kingdom includes a large variety of animals, all of which are classified as animals because of similarities in their structures. The two major groups of the animal kingdom are vertebrates (animals with backbones) and invertebrates (animals without backbones). Scientists have classified varied species of animals living in all parts of the world from the bottom of the ocean to the top of mountains. About 95 percent of the known species of animals are invertebrates.

In this activity, students classify animals as vertebrates or invertebrates and communicate differences among the groups. A large bulletin board will be needed for displaying activity cards. The board can be divided into two parts labeled VERTEBRATES and INVERTEBRATES. The activity will require two class periods. Lesson One includes discussion, brainstorming, classifying, and researching. Lesson Two allows time for students to complete research and concludes with a "Who Am I?" game.

Before beginning the activity, secure various reference materials such as encyclopedias, textbooks, and magazines.

Materials

- Bulletin board
- Handout: RESEARCH ASSIGNMENT SHEET
- Crayons
- Encyclopedias and other reference materials
- Magazines
- Containers for collecting index cards labeled Vertebrates, Invertebrates, and "Who Am I?" Game

For each student:
- Index cards, 3" x 5" (6)

Procedures

Lesson One

1. Invite students to volunteer their definitions of some animals. After discussing several definitions, remind

students that they may quickly think of animals such as dogs, cats, frogs, or horses, but that many other less common animals should also be considered, such as sponges, clams, earthworms, or fleas. Remind students, also, that animals abound in the ocean as well as on land.

2. Direct each student to list on a sheet of paper as many kinds of animals as he or she can. Have each student try to think of unusual animals that no one else would list. Caution that students must list only real animals.

3. Allow five to ten minutes for students to list animals.

4. After discussing the types of animals that students have listed, have them choose two of their most unusual animals to include on a class list.

5. Ask a selected number of students to contribute to the class list. Write all contributions on the chalkboard, but do not duplicate students' answers.

6. Have students categorize the animals listed as vertebrates or invertebrates. List answers in two columns on the chalkboard. If one list is noticeably shorter than the other, have students brainstorm to think of additional animals for the shorter list.

7. Distribute two index cards per student. Assign each student the task of printing the name of one animal on each index card. (Assign two animal names to each student.) As cards are completed, have students place them in one of the two containers labeled VERTEBRATES and INVERTEBRATES.

8. Shuffle the cards in both containers, and allow students to draw a card from each container.

9. Distribute copies of the handout REASEARCH ASSIGNMENT SHEET and four additional index cards to each student.

10. Explain to the class that they are about to do a research assignment, the results of which will create a bulletin board and a "Who Am I?" game for the class to play. Direct them to the four index cards, and explain that one is to be an information card and one a picture card for each animal they research. (Remind students that they will research two animals.)

OUTCOME 2 (Continued)
Procedures (Continued)

11. Review the assignment with them, and have them begin researching their two animals.

12. Carefully monitor students' work during the research activity.

13. Conclude the first lesson and explain that work will be completed on the following day.

Lesson Two

14. Have students complete their research assignment and place two cards on the chalkboard and two cards in the game box.

15. Divide the class into two teams to begin the second lesson of this activity. Have the teams play the game "Who Am I?" by allowing teams to take turns.

16. Read the animal characteristics aloud to the class, and have them match the characteristics with the appropriate picture card on the bulletin board. (Have students check the backs of the picture cards for verification of answers.) Replace cards incorrectly identified in the game box.

RESEARCH ASSIGNMENT SHEET
Handout

Your task is to research two animals, one vertebrate and one invertebrate. Use your textbook, encyclopedias, and any other available materials to collect information about your animals. Study pictures of the animals. Follow the steps listed as you complete your research on each animal.

1. Use your research material to determine if your animal is a vertebrate or an invertebrate.
2. Write vertebrate or invertebrate at the top of one index card. This is your information card. List five characteristics of the animal below the label, but do not name the animal. (This card will be used in a matching game.)
3. On the other index card, draw and color a picture of the animal or cut out a picture of the animal from a magazine. Write the name of the animal on the front of the card.
4. On the back of the picture card, list the five characteristics that you wrote on the matching animal information card.
5. When you have completed one information card and one picture card for each of your animals, pin your picture cards on the bulletin board under the appropriate classification. Place your information cards into the game box for "Who Am I?"

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Classification of Organisms
OUTCOME: 3. Classify plants into four phyla by their characteristics.

Background

According to some taxonomists, there are at least twenty divisions of the plant kingdom, but only four will be discussed in this activity. These four plant divisions are Pterophyta, Coniferophyta, Bryophyta, and Gnetophyta.

Pterophyta - Ferns are spore-producing plants with transport tubes. The transport tubes, which grow on the underside of the leaves, carry food and water to other parts of the plant. Ferns, which are seedless plants, usually grow in shady, damp environments such as the woods.

Coniferophyta - Conifers produce seeds in cones. They have transport tubes and needlelike leaves. Pine trees are members of the coniferophyta and bear cones of two types: male and female. Pollen from one type of cone fertilizes the other cone which bears the seeds. Most conifers are evergreens. They are used for lumber, to make turpentine, and other purposes.

Bryophyta - These plants, found on damp land, have rootlike and stemlike parts and simple leaves. They contain chlorophyll; therefore, they are green in color. They cannot manufacture their own food and do not produce flowers, fruits, or seeds.

Gnetophyta - These plants are gymnosperms even though they have many angiospermlike features. They have seeds that are unprotected and lie on the scales.

Materials

- Hand lens
- Ferns

Procedures

1. Explain to the students that plants are classified into four phyla by their characteristics.

OUTCOME 3 (Continued)
Procedures (Continued)

2. Write the four phyla on the chalkboard. (They are Pterophyta, Coniferophyta, Bryophyta, and Gnetophyta.) Discuss characteristics of each phyla.
3. Tell students to make a collection of ferns. Examine the ferns with a hand lens. Look for spore cases on the underside of the plant. Have students classify ferns into the correct phyla. (Pterophyta)
4. Tell students to bring different plant samples to school and attempt to classify them.
5. Have students make a display of the plant samples and label them with the appropriate names. (Be sure to include samples from each phyla.)

Extension

Have interested students investigate other phyla of the plant kingdom.

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Classification of Organisms
OUTCOME: 4. Identify types of fungi by characteristics.

Background

There are almost one million different kinds of fungi. The most common fungi include molds, mildews, rust, yeast, smut, and mushrooms. Fungi cannot manufacture their own food and do not contain chlorophyll. Some fungi are parasites, getting their food from other organisms. Some fungi are saprophytes: They get their food from dead plants and animals, or from materials made from plants and animals.

Molds grow on food, leather, paper, and wood. All molds reproduce by formation of spores. Some are harmful and some are helpful. Some molds that grow on food are harmful, but molds that are used in making cheeses and antibiotics are helpful. Mildews are parasites; they reproduce by spore formation. They attack plants such as roses, grapes, apples, potatoes, sugar cane, and tobacco.

Rust is a parasitic fungus. It destroys food crops as well as ornamental plants. Yeast is important for fermentation, for the making of bread, and for vitamin B_2. Smut is a parasitic fungus which attacks and destroys cereal grain crops. Mushrooms are saprophytes. Some mushrooms are edible, while others may be poisonous.

Materials

For each group:
- Magnifying glass or microscope
- Water
- Jar
- Cheese
- Bread, stale
- Mushrooms, purchased at grocery store

Procedures

1. Explain to students the most common fungi include molds, mildews, rust, yeast, smut, and mushrooms. Give characteristics for each type of fungi.

2. Assign students to groups of five. Give each group a jar, some cheese, and some stale bread.

OUTCOME 4 (Continued)
Procedures (Continued)

3. Direct the students to place some cheese in a jar and to close the lid tightly. Have students place the jar in a warm, dark place for several days. Examine to see if any mold has grown on the cheese.

4. Have students take the bread that has been left uncovered for a few days, moisten the bread, and observe it for several days to examine the formation of mold.

5. Direct the students to use a magnifying glass or microscope to observe the mold.

6. Bring to class mushrooms that were purchased at a local store so that the different parts (stalk, cap, and gills) can be examined. Caution the students not to eat the mushrooms.

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Classification of Organisms
OUTCOME 5. Identify major groups of bacteria and viruses.

Background

Bacteria are divided into groups according to shape. Round or bead-shaped bacteria are called cocci; rod-shaped ones are called bacilli; and those that are shaped like spirals are called spirilla. (Singular = coccus, bacillus, and spirillum)

Scientists are divided on their thoughts regarding viruses being living or non-living. Viruses are classified according to where they are found. Bacterial viruses live inside the cells of bacteria. These look like tadpoles and are called bacteriophages. Plant viruses live in flowering plants and inside the cells of seed plants. These viruses are spread by insects.

Animal viruses and human viruses cause many diseases. They live in the cells of animals and humans. Some viral diseases include some types of colds, pneumonia, measles, and chicken pox.

There are differences between viruses and bacteria. Viruses are parasites. They are active only inside cells, where they live and grow. Viruses act like living things when they are inside the cell. They are inactive outside the cell. Bacteria can be found everywhere: in the air, in dead plants and animals, in garbage, in oceans and ponds, and inside human bodies. Although there are several kinds of bacteria, they all must have a suitable environment to live and grow. Most bacteria need warmth, moisture, and a food supply for growth. Very cold temperatures retard the growth of bacteria, and very high temperatures kill them.

Materials

- Encyclopedias
- Other reference books
- Transparency Master: BACTERIA

Procedures

1. Discuss with students the differences between viruses and bacteria.

2. Ask students to name some of the more common viral diseases. (Some types are colds, pneumonia, measles, and chicken pox.)

OUTCOME 5 (Continued)

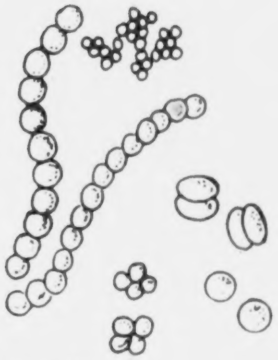
Procedures (Continued)

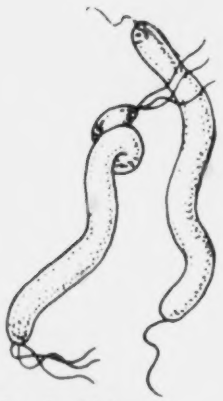
3. Explain to the students the major groups of bacteria according to their shapes, and the major groups of viruses according to where they are found.

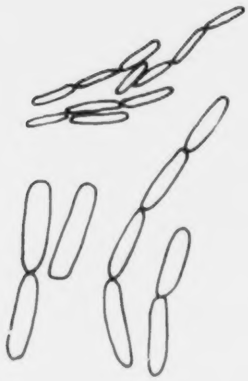
4. Have students draw the three main groups of bacteria: cocci, bacilli, and spirilla from the transparency BACTERIA in their notebooks.

5. Assign different topics to students for research. Sample topics include the following: The Use of Bacteria in the Production of Certain Foods (cheese, yogurt, tofu,); What is Being Done to Control Some Diseases Caused by Viruses; The Contributions of Louis Pasteur; or The Contributions of Edward Jenner.

BACTERIA
Tranparency


Cocci


Spirilla


Bacilli

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Classification of Organisms
OUTCOME: 6. Identify basic groups of protozoans.

Background

Protozoans are one-celled organisms. The majority of protozoans live in water, but some live in soil. Despite their small size, protozoans perform the same metabolic functions of higher order animals: digestion, excretion, respiration, and coordination of movement. The amoeba propels itself by pushing cytoplasm against its cell wall. Amoebas eat other protozoans by surrounding them with their bodies and ingesting them. The paramecium is a protozoan with many hairlike projections on its body. These hairs (cilia) move in a wavelike motion to propel the paramecium. Paramecia feed on other small organisms. Euglena are unusual in that they have chloroplasts and make their own food. They propel themselves with a taillike structure (flagellum) that whips along in a circular motion.

Materials

- Microscope
- Clean slide (1 per microscope)
- Coverslip (1 per slide)
- Dropper
- Jar of stagnant pond water
- Mashed rice, uncooked

For each student:
- Handout: PROTOZOAN IDENTIFICATION

Procedures

1. Explain to the students the characteristics of protozoans, their movement patterns, and their main parts. Discuss and compare the differences among the three most common types of protozoans.

2. Give one student a jar of pond water. Direct the student to add a small amount of rice to the water in the jar. Punch holes in the jar lid, cover the jar tightly with the lid, and place it in a warm place.

3. Test periodically for the appearance of organisms. After a few days, direct students in preparing slides for viewing. Have some students place drops of pond water on slides and cover them with coverslips. (If the protozoans swim off a slide before they can be seen, place some cotton fiber on the slide to hold them in place.)

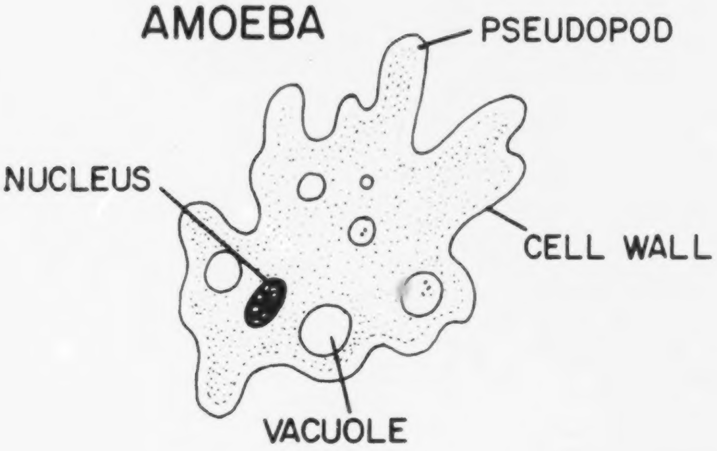
OUTCOME 6 (Continued)
Procedures (Continued)

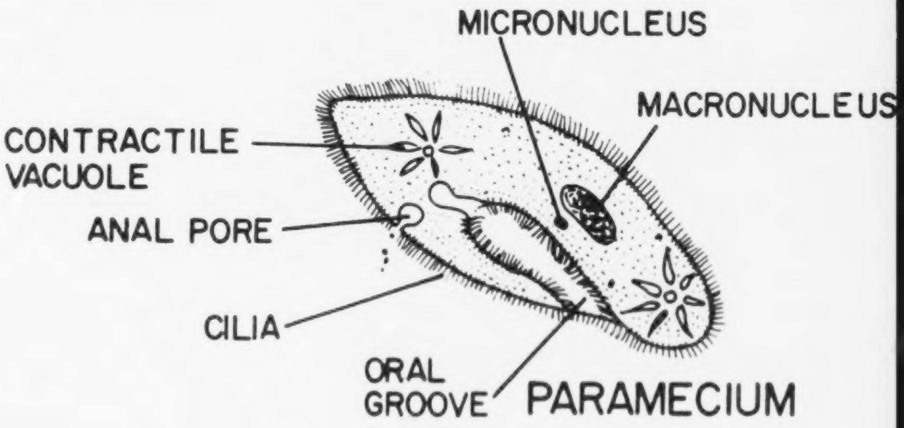
4. Give each student the handout PROTOZOAN IDENTIFICATION. Tell the students to study the drawings and to ask questions about any part that they do not understand. NOTE: There may be many types of protozoans on the slide. The three shown on the handout are the ones studied in this activity and the three most common types of protozoans.

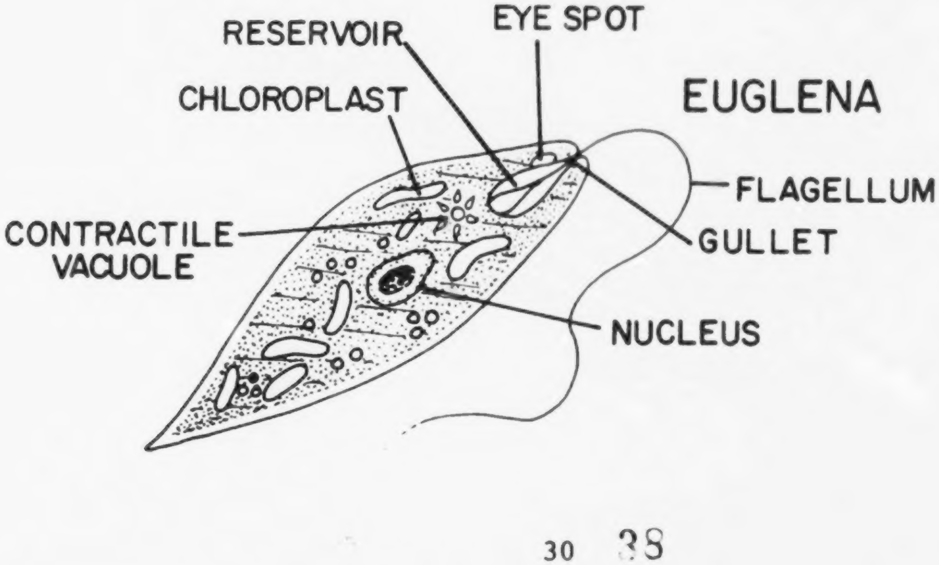
5. Direct the students to place the prepared slides under the microscope(s) and observe the organisms in the water droplets. Have each student view the slides even if there is only one available microscope.

6. Direct students to sketch on a sheet of paper the protozoans they observe. Tell them to identify each protozoan observed and attempt to label the nucleus, cell membrane, and cilia. They may refer to the handout PROTOZOAN IDENTIFICATION if necessary.

PROTOZOAN IDENTIFICATION
Handout


AMOEBA
PSEUDOPOD
NUCLEUS
CELL WALL
VACUOLE


MICRONUCLEUS
MACRONUCLEUS
CONTRACTILE VACUOLE
ANAL PORE
CILIA
ORAL GROOVE
PARAMECIUM


RESERVOIR
EYE SPOT
CHLOROPLAST
EUGLENA
FLAGELLUM
CONTRACTILE VACUOLE
GULLET
NUCLEUS

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Cells, Tissues, and Organs
OUTCOME: 7. Identify differences between plant and animal cells.

OUTCOME: 8. Compare different types of cells and their functions.

Background

Every living thing is made of one or more cells. Most animal cells are alike in that they have a nucleus, a round body inside the cell that controls the cell's activities. The nucleus contains threadlike structures called chromosomes. Genes, which are present on the chromosomes, control the cell activities. That is why it is said that the nucleus is the control center of the cell. Outside the nucleus is a jellylike substance called cytoplasm. The clear areas in the cytoplasm are vacuoles in which food and/or waste is stored. The cell membrane surrounds the animal cell. The membrane controls the movement of materials into and out of the cell.

The plant cell, like the animal cell, has a nucleus, cytoplasm, and cell membrane. The cell membrane is very thin. The cell wall is nonliving. It gives the cell its shape and strength. The plant cell contains chloroplasts which contain the chlorophyll that helps the plant cell make food. Plant cells have vacuoles that are much larger than the ones in the animal cells.

Each cell in the human body performs certain basic functions such as absorbing nutrients and oxygen, burning nutrients and oxygen, and secreting waste products. Other functions include repair, growth, and reproduction of cells. Although all cells perform certain basic functions, they differ in shape and in the specific tasks they perform. There are many kinds of cells in the human body. Blood cells are used to fight infections and repair damaged cells. Skin cells are the protective covering of the body. They form the first line of defense against diseases. Skin cells continue to reproduce and to replace cells that are worn and cells that are dead. Muscle cells have long, threadlike parts that carry messages to and from one nerve cell to another. Bone cells reproduce to make bones longer, larger, and stronger. These bone cells form the protective structure for organisms.

Prior to the class, make a transparency of the visuals provided in the activity.

OUTCOMES 7 and 8 (Continued)

Materials

- Transparency Master: ANIMAL AND PLANT CELLS
- Transparency Master: DIFFERENT TYPES OF CELLS

Procedures

1. Direct the students' attention to the drawings or the transparency ANIMAL AND PLANT CELLS.

2. Discuss with the students the similarities and differences between the animal and plant cells. Emphasize the specific functions of each part for both types of cells.

3. Direct the students' attention to the drawings or the transparency DIFFERENT TYPES OF CELLS.

4. Have the students compare the different types and shapes of the cells. NOTE: Remind students that a group of cells (such as bone, muscle, and skin cells) form tissues.

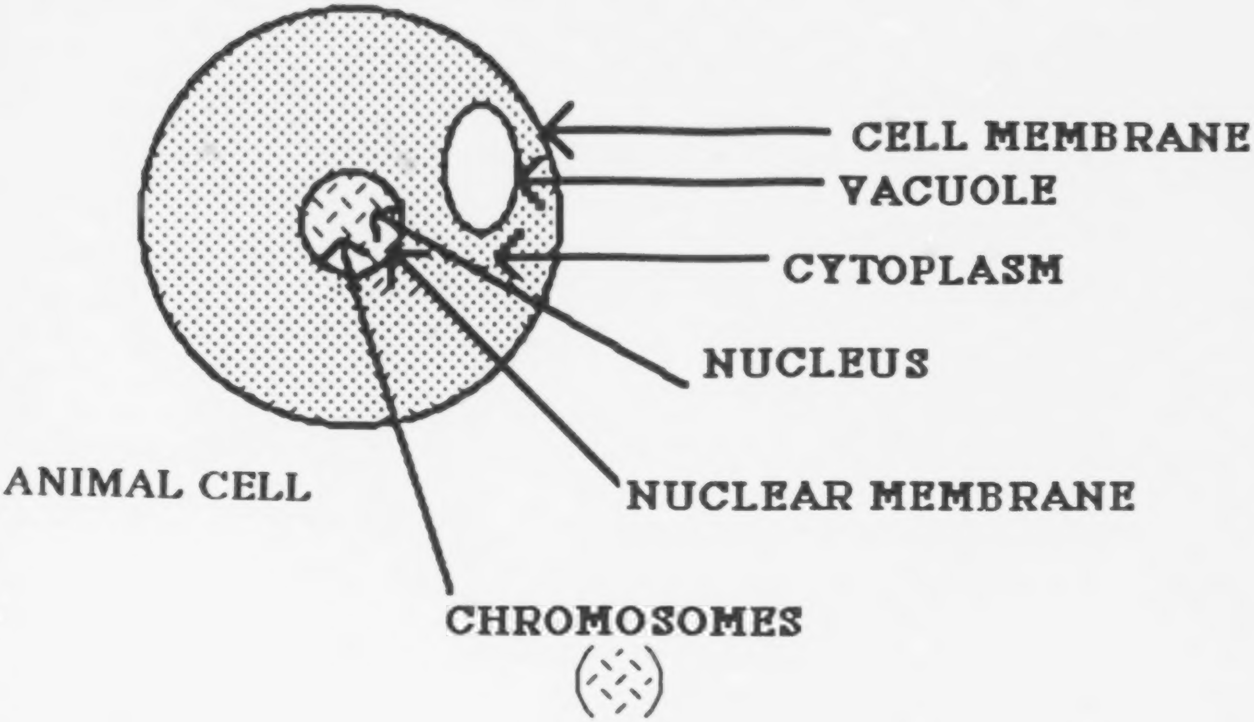
5. Explain to the students that not only do the cells differ in shape, but they also perform specific tasks. Discuss the specific tasks of each cell found in the background.

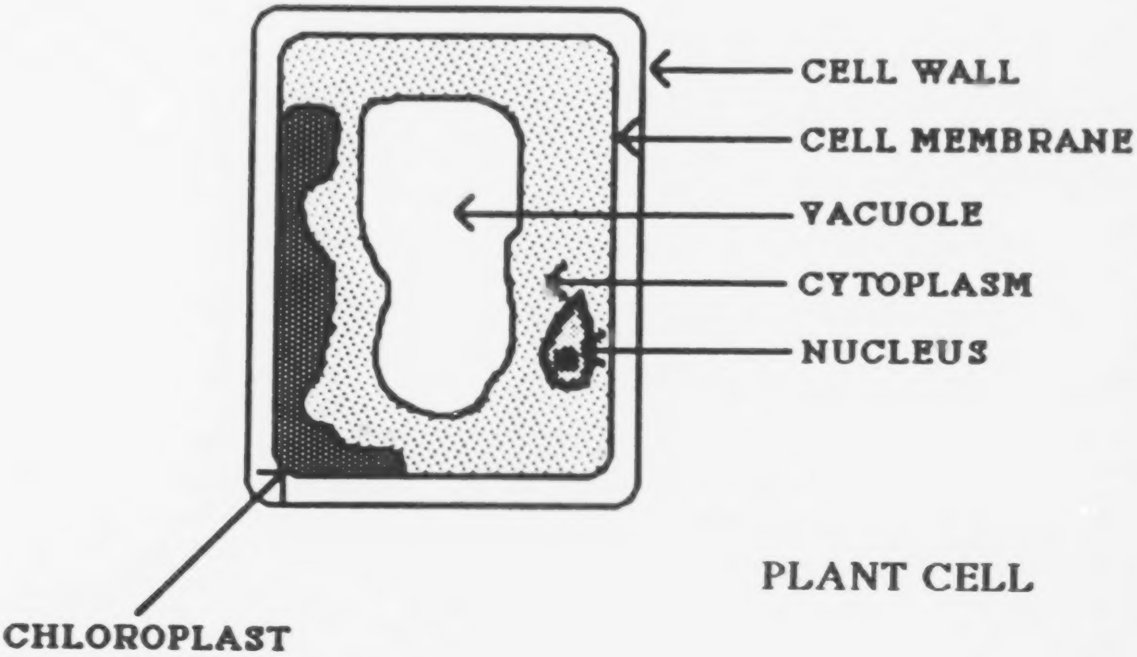
Extensions

1. Have students view the slide of a cheek cell, then draw and label all the parts.

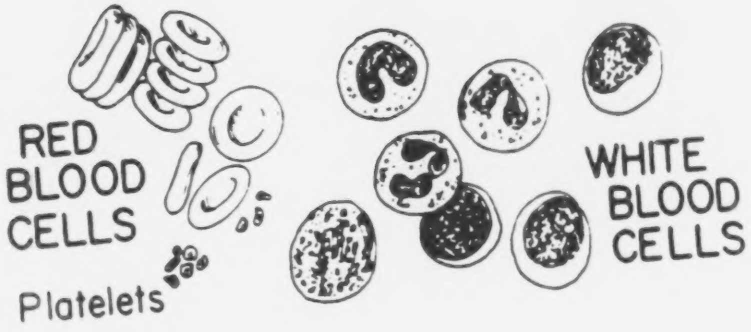
2. Have students view prepared slides of a bone or cartilage cell, a nerve cell, a blood cell, and a skin cell.

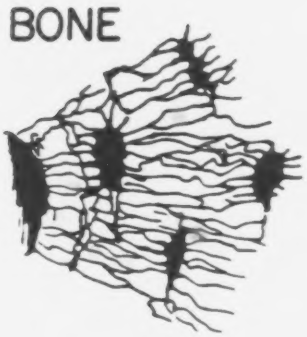
ANIMAL AND PLANT CELLS
Transparency

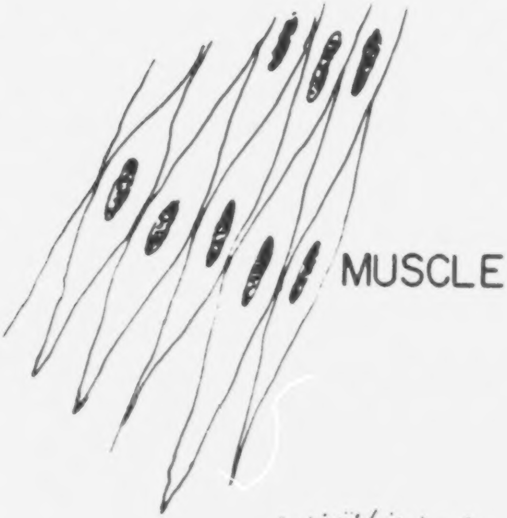

CELL MEMBRANE
VACUOLE
CYTOPLASM
NUCLEUS
ANIMAL CELL
NUCLEAR MEMBRANE
CHROMOSOMES

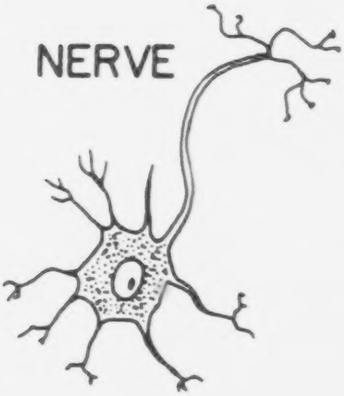

CELL WALL
CELL MEMBRANE
VACUOLE
CYTOPLASM
NUCLEUS
PLANT CELL
CHLOROPLAST

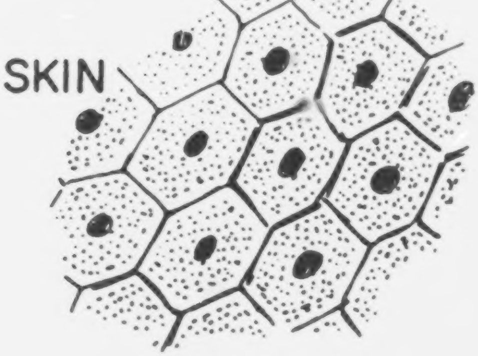
DIFFERENT TYPES OF CELLS
Transparency


RED
BLOOD
CELLS
Platelets
WHITE
BLOOD
CELLS









GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Cells, Tissue, and Organs
OUTCOME: 9. Describe the relationship between cells and tissues.

Background

Tissues are groups of cells that do the same activity or work. Examples of plant tissues are the skin of an onion, the bark of a tree, and the pith of a stem. Examples of animal tissues are bone tissue, skin tissue, muscle tissue, nerve tissue, blood tissue, and connective tissue.

In the skin, different kinds of cells do different kinds of jobs. Special cells in the skin exude small amounts of oil. The oil helps to protect the skin from drying out. These and other skin cells help to protect the body's surface. Use the transparency CROSS SECTION OF THE SKIN to show the different layers of the skin. The skin which is made of many kinds of tissue produces oil. The little pits out of which tiny hairs grow begin in the dermis. Oil glands are located near the roots of the hairs. Oil flows along the root shafts to the skin surface. The oil prevents the skin from drying and cracking.

The following activity will last one class period. The activity will allow the students to examine their skin and identify the cells (tissue) that work together to produce oil.

Materials

- Food coloring, any color
- Eye droppers (12)
- Transparency Master: CROSS SECTION OF THE SKIN
- Transparency Master: CELLS AND TISSUES

For each student:
- Handout: OBSERVATIONS OF CELLS AND TISSUES

Procedures

Part A. Studying the relationship between cells and tissues

1. Tell the students that human bodies are composed of cells. Explain that groups of similar cells work together to do the same activity or work and that these cells are called tissues.

Procedures (Continued)

2. Show the transparency CELLS AND TISSUES which illustrates that cells performing the same function form tissues. Highlight the groups of cells that form the bone, muscle, nerve, and skin tissues.

3. Show the transparency CROSS SECTION OF THE SKIN and point out the different layers of the skin. Emphasize to students the various cells and tissues found in each layer. (Epidermis, dermis, and subcutaneous layers)

4. Showing the transparency CROSS SECTION OF THE SKIN, ask the students to tell where the oil glands are located. (Near the root of the hairs.) Tell the students that certain tissues in the skin secrete oil. Explain to students that the oil moves along the root shafts to the surface of the skin and keeps the skin from becoming dry and cracked.

Part B. Investigating the skin

1. Divide the class into pairs.

2. Distribute the handout OBSERVATION OF CELLS AND TISSUES to students.

3. Have one student use the medicine dropper to place a tiny drop of food coloring on his or her partner's

    A. Palm.

    B. Back of hand.

    C. Inside of arm near the elbow.

    D. Tip of thumb.

    E. Outside of arm near the elbow.

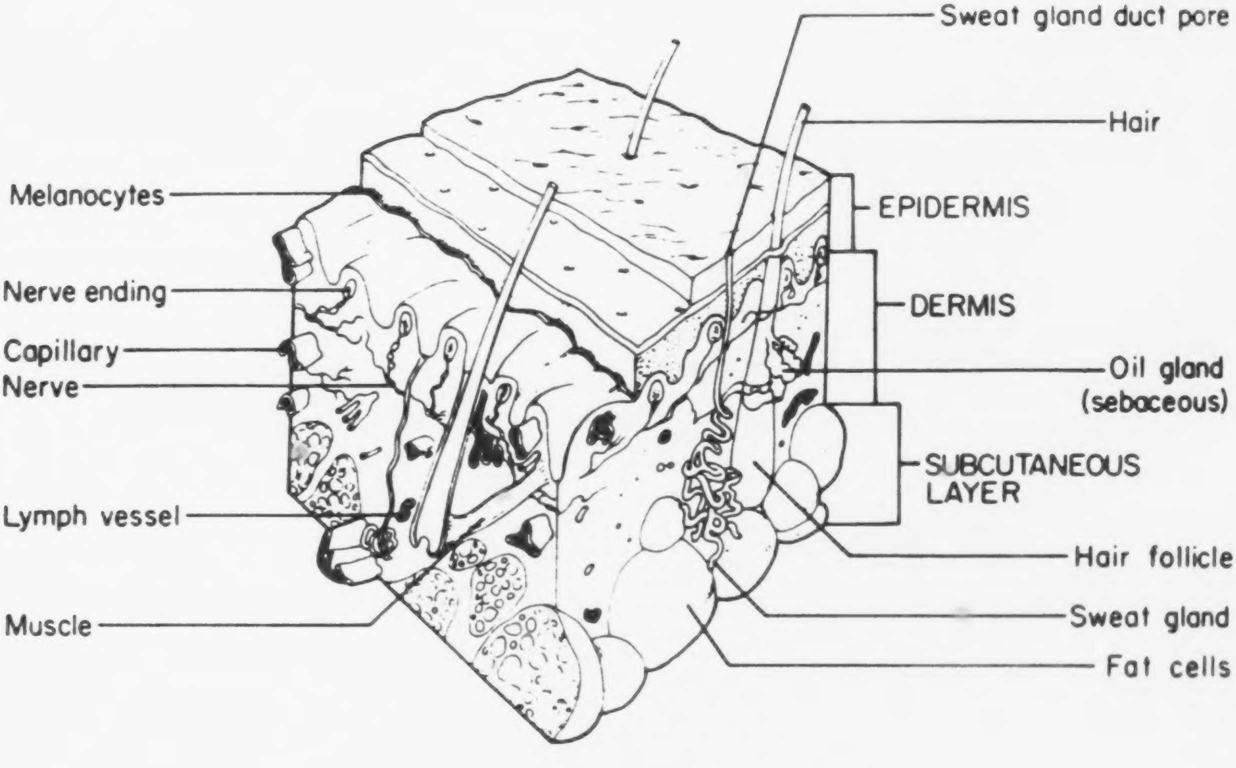
4. Direct the first student to allow the drops to dry, observe what happens with each drop of coloring, and record the observations on the handout OBSERVATIONS OF CELLS AND TISSUES.

5. Have the second student follow the same procedure.

6. Direct each student to answer the questions on the handout OBSERVATIONS OF CELLS AND TISSUES.

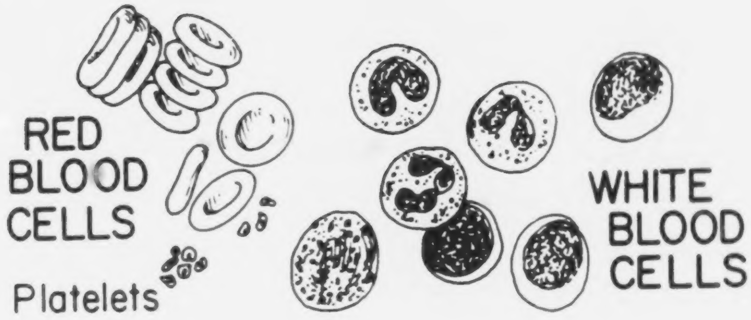
7. Discuss the observations and the answers to the questions with the class.

CROSS SECTION OF THE SKIN
Transparency

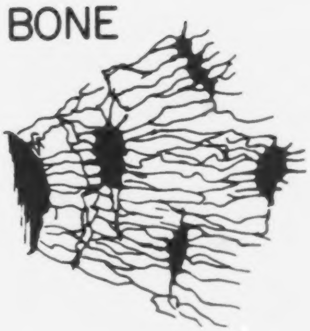


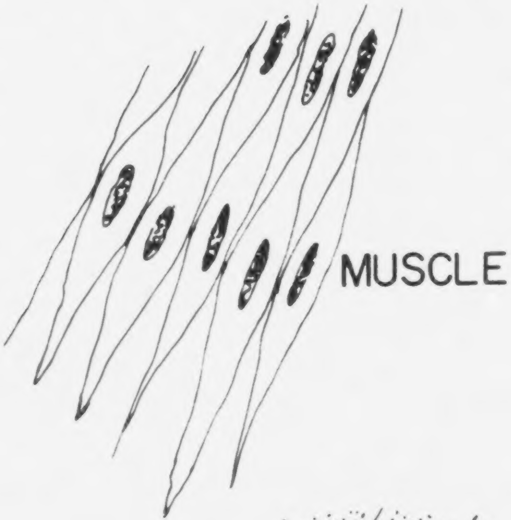
Sweat gland duct pore
Hair
Melanocytes
EPIDERMIS
Nerve ending
DERMIS
Capillary
Nerve
Oil gland (sebaceous)
SUBCUTANEOUS LAYER
Lymph vessel
Hair follicle
Sweat gland
Muscle
Fat cells

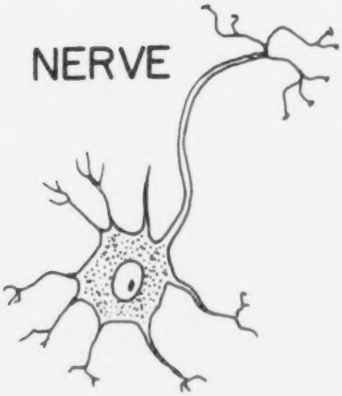
CELLS AND TISSUES
Transparency

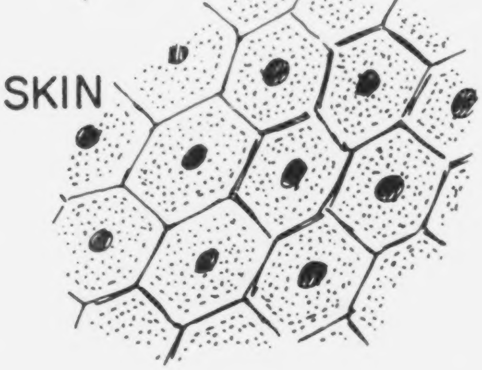

RED
BLOOD
CELLS
Platelets
WHITE
BLOOD
CELLS

TISSUES









OBSERVATIONS OF CELLS AND TISSUES
Handout

SKIN AREA	OBSERVATION
A. Palm	
B. Back of hand	
C. Inside arm	
D. Tip of thumb	
E. Outside arm	

Answer the following questions.

1. Did the food coloring stains differ in each place?

2. How did they differ?

3. Why do you think this happened?

4. Rub the side of your nose with your index finger and then rub your index finger against your thumb. What do you feel?

5. Rub a tissue along the side of your nose. What do you see?

6. Explain how the tissues that make the oil glands help the skin.

7. Explain why people who wash dishes often use hand cream.

OBSERVATION OF CELLS AND TISSUES
Key

SKIN AREA	OBSERVATION
A. Palm	
B. Back of hand	
C. Inside arm	
D. Tip of thumb	
E. Outside arm	

Answer the following questions.

1. Did the food coloring stains differ in each place? **(Yes)**

2. How did they differ? **(Will vary because some body areas are drier than other body areas.)**

3. Why do you think this happened? **(Some body areas that are more protected and oily will keep the stain longer.)**

4. Rub the side of your nose with your index finger and then rub your index finger against your thumb. What do you feel? **(Oil)**

5. Rub a tissue along the side of your nose. What do you see? **(an oil stain)**

6. Explain how the tissues that make the oil glands help the skin. **(Secrete oil and keep the skin from drying)**

7. Explain why people who wash dishes often use hand cream. **(Washing dishes in hot, soapy water removes natural oil from the hands. To prevent their hands from becoming rough and dry, dishwashers add cream or oil to their hands.)**

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Cells, Tissues, and Organs
OUTCOME: 10. Compare the functions of different types of tissue.

Background

The skeleton is made of two kinds of tissue called bone and cartilage. In a bone, a large amount of hard mineral matter called calcium phosphate is found between the cells. This makes the bone very hard. Cartilage, which is a firm, elastic, and flexible connective tissue, is deposited between its cells.

The ears and ends of the nose contain cartilage. Cartilage discs between the bones of the back allow the back to bend easily. This cartilage prevents the bones of the back from rubbing together. Cartilage fastens the ribs to the breastbone. This cartilage allows ribs to move up and out while breathing.

The ends of long bones are covered with cartilage. Long bones are hollow and contain marrow that produces red blood cells. At the ends of the bones, long cords called ligaments tie the bones at the joints. The ligaments are very tough, strong cords that keep the bones from being pulled apart or moved in the wrong direction.

In the following activity, small groups will observe a chicken leg to determine the different kinds of tissues and discuss the functions of each tissue. Bone tissue, cartilage, and ligaments of the chicken leg will be observed. The activity will take one class period.

Materials

- Saw (to be used by the teacher only)
- Scissors (5)
- Chicken legs, whole (5)
- Pie pans, aluminum (5)
- Transparency Master: BONES AND LIGAMENTS

OUTCOME 10 (Continued)

Procedures

Part A. Discussion of different tissues and their functions

1. Tell students that the body is made of many kinds of tissues and that each tissue has a certain job to perform.

2. Ask students to describe bones and their purposes. Bones are hard and strong. They support the body, protect the important organs of the body, and give the body its shape. Ask the students to name some of the bones. (Skull, ribs, leg bones, arm bones, pelvic bone, and others) Ask the students to define a joint. (A joint is a place where two bones meet.) Have them name some locations of joints. (Elbow, knee, and others) Tell them elbows, fingers, and knees are hinge joints.

3. Tell students that joints must be strong, but they must also allow easy movement. Tell the students that at a joint, the ends of a bone are larger than the rest of the bone. The ends of bones are covered with cartilage, a strong, smooth material that protects the ends of bones. Bones will rub together and wear if they are not protected by cartilage.

4. Direct students to feel the bones in the middle of their chests. Explain that cartilage fastens the ribs to the chest bone and allows the chest to move up and out while breathing.

5. Direct students to feel their noses and ears. Ears and noses contain cartilage. Cartilage in the nose and ears gives them shape and support.

6. Tell students that long, strong cords called ligaments tie the bones together at joints. These ligaments prevent bones from pulling apart or moving in the wrong direction.

7. Show the transparency Bones and Ligaments. Ask the students to locate the bones and ligaments. Tell the students that the ligaments surround the joints and cover the cartilage and ends of the bones. Tell the students that the ligaments are composed of a strong, elastic-like material that stretches to allow the bones of the joint to move.

8. Emphasize that bone, cartilage, and ligaments are different kinds of tissues and have different functions.

Part B. Examination of a chicken joint

1. Divide the class into five small groups.

2. Tell each group to get a pair of scissors, an aluminum pie pan, and an uncooked chicken leg.

3. Tell the students to cut the meat off the bone very carefully using the scissors.

4. Direct the students to find the joint and bend the joint back and forth. Ask the students to identify the type of joint. (Hinge)

5. Tell the students to observe the joint and examine the ends of the bone. Tell them to describe these. (The ends of the bones are covered with a softer material.) Ask them what this material is called. (Cartilage) Ask them to tell the function of this tissue. (To prevent the bones from rubbing against each other)

6. Direct students to find the ligaments and to describe them. (Long cords that tie the bones of the leg together) Ask them to bend the joint. (They will observe that the ligaments did not break.) Ask them to explain why. (The ligaments are very strong.)

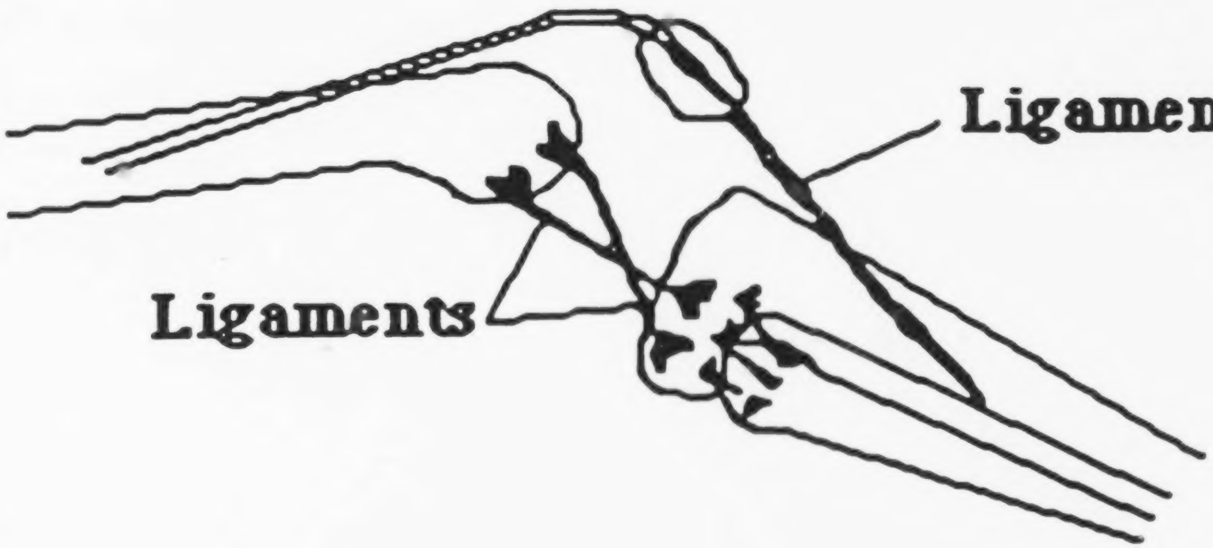
7. Direct students to cut the ligaments on one side and to look at the bones. Ask the students to describe the shape of these bones. (They are round.) Ask them to touch the cartilage and to describe it. (It feels smooth and slippery.) Ask them to explain why. (It is covered with an oily substance that oils the joint and allows it to move easily against the other bone of the chicken leg.)

8. Saw the bones into two sections. Ask the students to describe what they see. (The bone is hollow in the center and contains a reddish-colored substance.) Explain to the students that red blood cells are produced in the long bones.

9. Ask the students to compare the chicken joint with the transparency Bones and Ligaments. (Both are rounded at the ends, and the ends are covered with cartilage and tied together with ligaments.)

10. Tell the students that by examining different tissues they can observe how each tissue has a different function.

BONES AND LIGAMENTS
Transparency


Ligaments
Ligaments

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Cells, Tissues, and Organs
OUTCOME: 11. Describe the relationship between tissues and organs.

Background

Tissue is made of a group of cells performing a specific function. An organ is made of a group of tissues performing a specific function. An organ such as the lungs is made of many kinds of tissue. In the respiratory system the organs that function together are the trachea, the passageway by which air is carried into and out of the lungs; the left bronchus; and the right bronchus. Each bronchus enters one lobe of the lungs. The bronchi divide into smaller tubes called bronchioles. The bronchioles get smaller and smaller. At the ends of the bronchioles are tiny air sacs, called alveoli. The lungs are actually one great mass of these clusters of air sacs.

The various organs (the alveoli, the bronchioles, the left bronchus, the right bronchus) and tissues in the lungs all work together to bring air in and out of the body.

Materials

Transparency Master: LABEL THE LUNGS

For each group:
- Lungs of a cow or pig, obtained from a slaughter house
- Dissection kit
- Tray, plastic
- Butcher paper
- Table, large
- String or yarn (2 yards)
- Index cards, small (10)
- Scissors

For each student:
- Straws (2)
- Handout: LABEL THE LUNGS

Procedures

Part A. Discussion of Lungs

1. Show the transparency LABEL THE LUNGS and distribute handout LABEL THE LUNGS to students.

OUTCOME 11 (Continued)
Procedures (Continued)

2. Ask the students to identify the trachea, right bronchus, bronchioles, and alveoli. Explain to the students that the right lung has three lobes and the left lung has two lobes.

3. Ask the students to trace the movement of air through the lungs.

Part B. Dissection of the Lungs

1. Divide the class in small groups.

2. Cover the table(s) with white butcher paper and distribute materials to each group.

3. Place the lungs of a cow or a pig on a large plastic tray.

4. Ask the students to locate the left lung (with two lobes) and the right lung (with three lobes).

5. Turn the lungs over and identify the area where the heart should be located. (Center area at the back of lungs.)

6. Ask the students to locate the trachea.

7. Direct students to extend the fingers into the right bronchus to show how the trachea divides into the lungs. Ask students to feel the cartilage rings on the trachea.

8. Instruct the students to cut the trachea open to show the bronchus leading into one of the lungs.

9. Continue cutting through the bronchus to show how it continues to get smaller.

10. Direct students to take a straw and insert it into a small bronchiole and carefully blow air into the straw. (The lung should inflate in this area.)

11. Blow into different bronchioles to inflate various areas of the lungs.

12. Ask the students to note the weight of the organ and tissues.

Procedures (Continued)

13. Tell the students to use the index cards to label the following ten areas of the lung dissection:

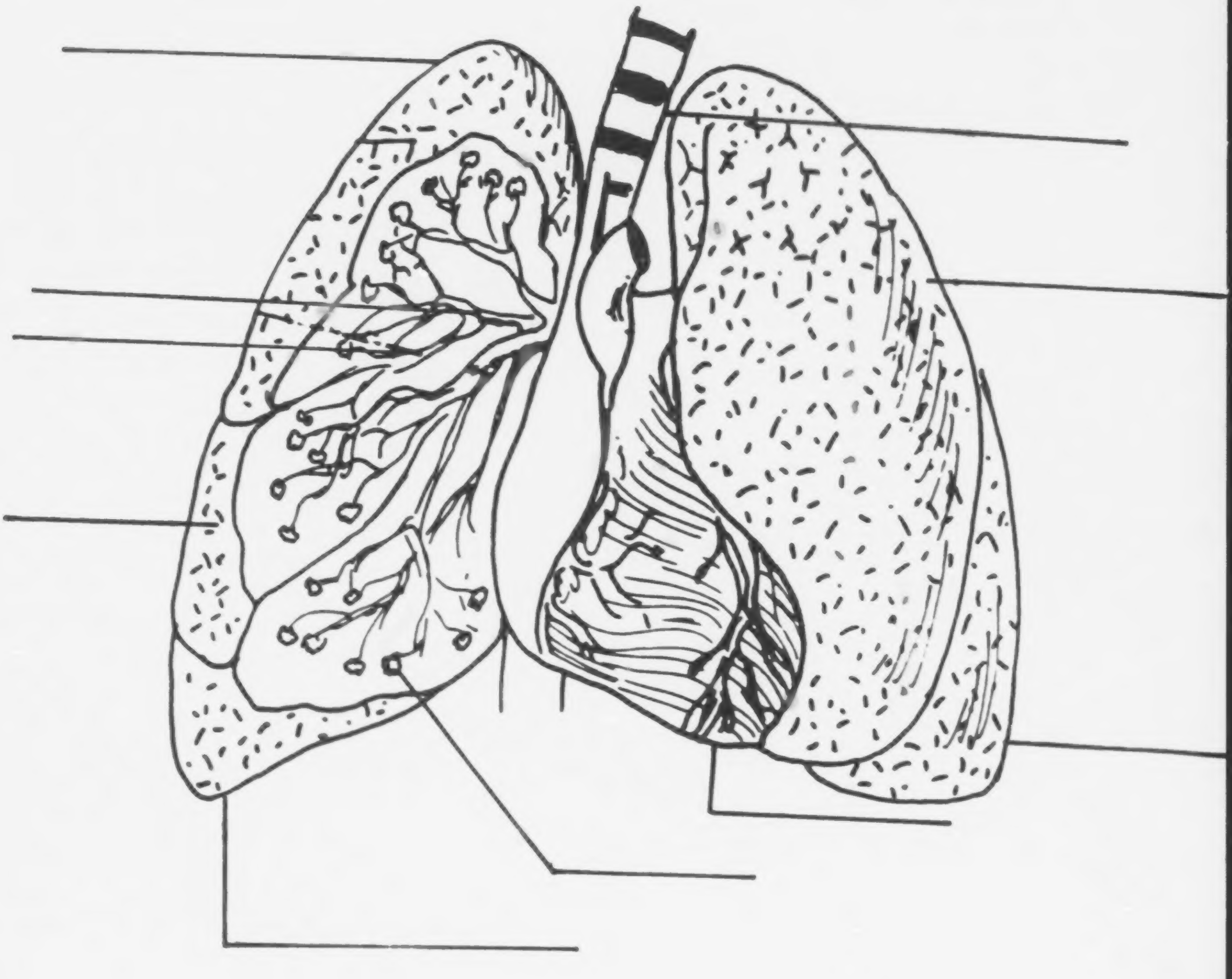
    a. Trachea
    b. Right bronchus
    c. Upper right lobe
    d. Middle right lobe
    e. Lower right lobe
    f. Bronchioles
    g. Upper left lobe
    h. Lower left lobe
    i. The area where the heart is found.

14. Have students cut ten lengths of yarn 8 to 10 inches each.

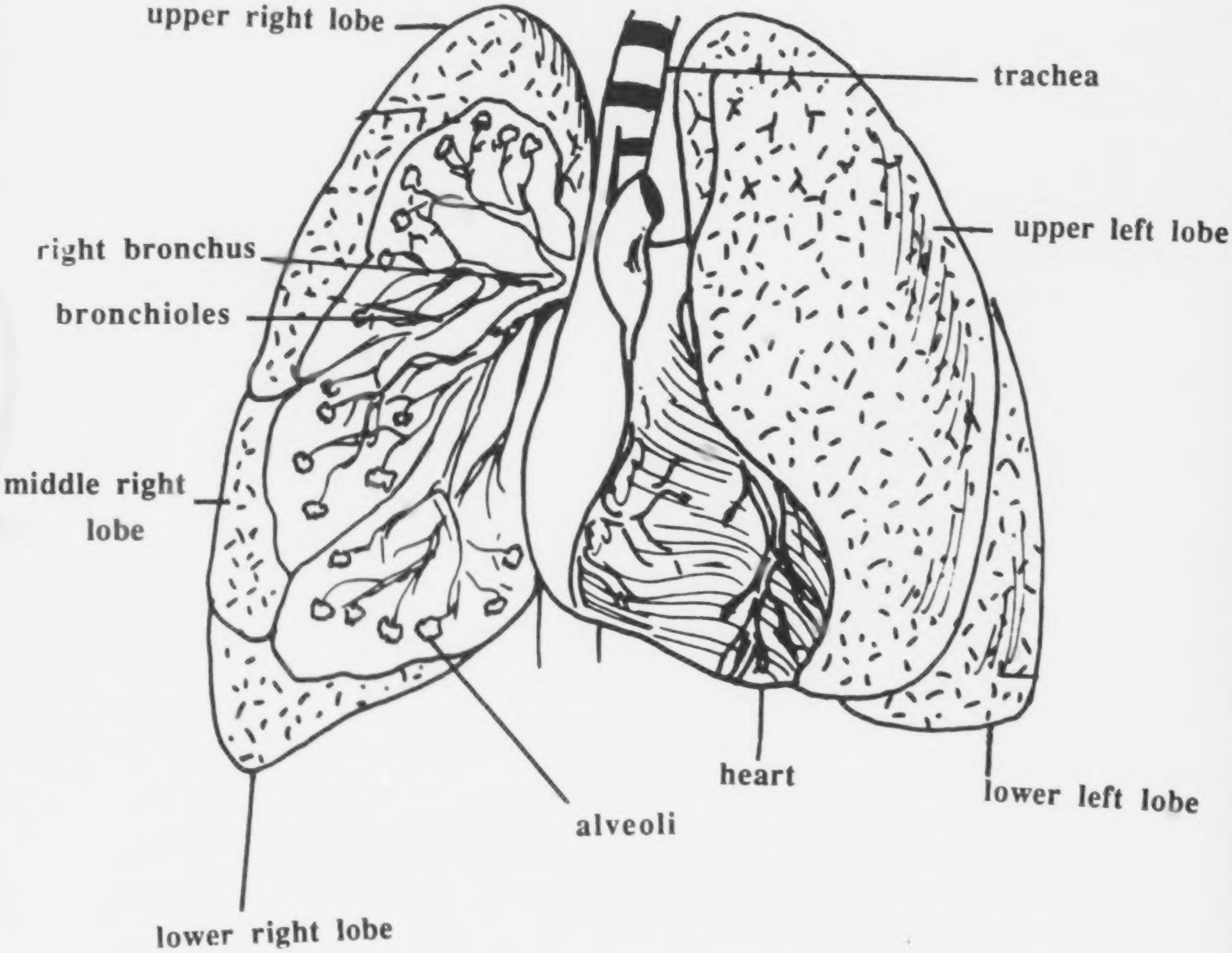
15. Tell the students to continue to work in small groups. Ask the students to label the lung dissection by placing one end of the yarn on the specific part and the other end of the yarn on the table. Place the labeled card on top of the end of the yarn on the table.

16. Check the labels to be sure they are placed correctly.

LABEL THE LUNGS
Handout



LABEL THE LUNGS
Key


upper right lobe
trachea
upper left lobe
right bronchus
bronchioles
middle right lobe
heart
lower left lobe
alveoli
lower right lobe

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Cells, Tissues, and Organs
OUTCOME: 12. Describe the relationship between organs and organ systems.

OUTCOME: 13. Compare the functions of different types of organs and organ systems.

Background

An organ is a group of different tissues working together to perform the same function or functions. A group of organs that work together on a special body activity is called an organ system.

There are ten major systems in the human body. The systems are:

1. Endocrine - controls body functions through chemicals released into the blood by a series of ductless glands
2. Reproductive - provides a means for the production of young
3. Skeletal - provides shape, support, protection, and an attachment point for the muscles
4. Muscular - provides movement, shape, and support in partnership with the skeletal system
5. Integumentary - provides protection and means for regulating body temperature
6. Nervous - regulates and maintains bodily functions through a system of nerves which carry "messages" all over the body
7. Circulatory - carries nourishment and oxygen throughout the body and removes wastes
8. Respiratory - brings oxygen into the body and carries some wastes (carbon dioxide) out of the body

OUTCOMES 12 and 13 (Continued)
Background (Continued)

9. Digestive - breaks down food into a form that is usable by the body's cells and eliminates solid wastes

10. Excretory - separates and eliminates liquid wastes from the blood

Systems Bingo is a game used as a part of the activity to help the students become familiar with the systems of the body and the organs within them. Students must be familiar with the names of organs that make each system before the activity is presented.

Before the game can be played, the name of each listed organ must be written on a slip of paper or an index card and placed in a shoebox. At least two slips of paper for each organ name should be prepared.

A list of organs is included to be written on the chalkboard. The systems associated with the organs are numbered according to the background information and written in parentheses. Note that only six of the ten systems are emphasized in this activity.

ORGANS TO BE WRITTEN ON THE BOARD

Thyroid Gland (1)
Arteries (7)
Stomach (9)
Heart (7)
Small Intestine (9)
Large Intestine (9)
Brain (6)
Lungs (8)
Bladder (10)
Gall Bladder (9)
Adrenal glands (1)

Esophagus (9)
Nerves (6)
Pancreas (9)
Salivary glands (9)
Kidneys (10)
Trachea (8)
Spinal cord (6)
Liver (9)
Mouth (9)
Islands of Langerhans (9)

Nose (8)
Bronchus (Left) (8)
Throat (9)
Bronchus (Right) (9)
Blood (7)
Diaphragm (8)
Veins (7)
Pituitary gland (1)
Parathyroid (1)

OUTCOMES 12 and 13 (Continued)

Materials

- Shoebox
- Scissors

For each student:
- Handout: SYSTEMS BINGO (2)
- Construction paper
- Pencils or pens

Procedures

1. Give each student the handout SYSTEMS BINGO.

2. Tell the students to select twenty-four terms from the list on the chalkboard and place each term in a separate square on one of the SYSTEMS BINGO handouts. Ask them to choose randomly from the list.

3. Tell the students to cut twenty-four squares of construction paper to use as covers for bingo squares. They may use the second SYSTEMS BINGO card as a pattern for the squares.

4. Select a card or a slip of paper from the Systems Bingo Box (a shoebox containing slips of paper upon which names of the organs are listed).

5. Announce the name of the organ listed on the slip of paper.

6. Tell each student to cover the appropriate square if the name of the organ is listed on his or her SYSTEMS BINGO handout.

7. Tell the students that they can BINGO in a straight line up, down, or diagonally.

8. Repeat procedures numbered 4, 5, and 6 until a student calls "BINGO."

9. When a student calls "BINGO," he or she must uncover his or her squares, name the organs underneath, and also name the systems to which the organs belong. (Note that on page 49 the of list ORGANS TO BE WRITTEN ON THE BOARD shows the names of the systems to which the organs belong.)

SYSTEMS BINGO
Handout

		✕		

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Interdependence of Organisms
OUTCOME: 14. State reasons why many plants and animals have become extinct and others are endangered.

OUTCOME: 15. Identify possible ways to protect plants and animals from extinction or endangerment.

Background

Extinctions have accelerated since the early 1600s. This acceleration has been caused in part by human activities such as hunting, trapping, and destruction of native habitats in order to make room for human settlements. New settlers also introduced new species of plants and animals into areas they settled. The results were often detrimental to native populations as the newcomers competed with them for food and living space. Overpopulation in one group of organisms affects the welfare of other groups, sometimes with disastrous results. Overgrazing of range land in western states has led to almost total destruction of native grasses that were suited to arid and semiarid conditions. These native grasses provided adequate grazing for the native populations. They could not, however, recover from the excessive grazing of large herds of cattle, sheep, and horses.

In recent times, environmental pollution, pesticides, and industrial wastes have been recognized as contributing to the decline of plant and animal species. Preserving the habitats of endangered species is a continuing problem as the human population increases and expands into areas where coexistence with native populations is not possible.

Conservationists are concerned with protecting the environment and preserving the earth for the benefit of all. They recognize that plants and animals (humans included) are dependent upon each other for their survival. National parks have been set aside to provide wilderness areas for plants and animals to live in their natural states with little intervention from park managers. Many people believe, however, that even more land needs to be reserved for the benefit of endangered species, a benefit that eventually filters to humankind. The Environmental Protection Agency (EPA) was established by the United States Federal Government to help safeguard the environment. Citizens' groups, such as the Sierra Club, are working diligently to help save endangered species. The mass media have also increased their efforts to educate the public regarding present dangers to the environment and to the earth's inhabitants.

OUTCOMES 14 and 15 (Continued)

Background (Continued)

Some possible solutions to the problem of endangerment are as follows: (1) clean the pollution in our air, water, and soil; (2) raise endangered species under controlled conditions; (3) control populations to achieve balance among organisms; (4) reduce the use of pesticides on food crops; (5) recognize other organisms' rights to exist; and (6) protect habitats.

Materials

- Magazines
- Reference materials
- Newspaper articles

Procedures

1. Explain to the students that the extinction of species is not a new phenomenon, but that extinctions have been increasing over the past 300 years. Tell them that the rate at which species are vanishing is alarming, especially now that we are realizing the extent to which plants and animals are dependent upon each other for their survival. Explain how many plants and animals might be saved from extinction, and cite the names of groups that are actively working to save plants and animals that are endangered.

2. Assign students to groups of four or five.

3. Assign research topics on pollution, conservation, natural selection, and extinction. Instruct the students to report on the aspects of these topics as they relate to the protection of plants and animals from extinction or endagerment.

4. Direct each group to select a person to present an oral report on each topic.

5. Lead a discussion after the reports have been given. Ask questions that encourage the students to think critically about the extinction or endangerment of plants and animals. Ask questions similar to the following: What happens to the garbage from our homes? Where does the waste water go when we flush the toilet or drain the bathtub? How do garbage and waste water affect other organisms? What possible harm can result from a balloon launch? Why do farmers use pesticides on their crops? How might pests be controlled without using pesticides on plants?

OUTCOMES 14 and 15 (Continued)

Procedures (Continued)

6. Direct students to write their conclusions at the end of the discussion. Display selected papers on the bulletin board after they are read by the writers to the class.

Extension

Ask if any students have watched a television program related to the subject of extinction or endangerment of animals or plants. Tell them to discuss any program that may relate to the subject. Ask them to provide solutions to the problems presented during the program.

GRADE 5
LIFE SCIENCE

UNIT: Organisms
TOPIC: Interdependence of Organisms
OUTCOME: 16. Discover how plants and animals adapt to environmental conditions.

Background

The evolution of species is governed primarily by two processes: heredity and natural selection. A variation among a species is the result of an organism's adaptation to its environment. Natural selection enables a species to develop characteristics that help it to survive in its environment. For instance, the tall prickly pears on the Galapagos Islands were able to extend their height so that the giant tortoises living there were unable to eat them to the point of extinction. If an organism cannot adapt to changes in its environment, it will die. Some organisms tend to bear fewer offspring when food is in short supply; others die as the stronger ones take the food that is available.

Heredity is the transmission of the parents' characteristics to their offspring. These characteristics are carried by chromosomes (which contain genes) that determine the individual characteristics of the organism. Sometimes offspring have characteristics which differ from those of the parents due to mutation.

Scientists believe that species appear in response to some type of isolation (geographical, ecological, or genetic). Most adaptations of species occurred over long periods of time; however, some changes have been apparent over short periods of time. The peppered moth of Great Britain underwent a rapid change in coloration in response to environmental conditions. Other examples of such adaptations are organisms that become resistant to antibiotics or pesticides over a period of time, organisms that change in size or length due to environmental conditions, and organisms that change in color for survival.

Materials

For each group:
- Reference materials
- Dictionaries

OUTCOME 16 (Continued)

Procedures

1. Explain how plants and animals adapt to environmental conditions. Divide students into small groups of four.

2. Have students define the following terms: evolution, natural selection, species, heredity, chromosomes, genes, mutation, isolation, and immune system. Give assistance if necessary.

3. Assign a topic to each group for discussion. Include topics such as Main Ideas of Evolutionary Theory, Natural Selection, Heredity, Development of New Species, and Adaptations in Organisms. Provide dictionaries and reference materials to each group.

4. Have students discuss their assigned topics. Ask them to provide specific examples of how some plants and some animals have adapted to changes in the environment.

5. Ask for volunteers to report on the behavior of lemmings. Tell the students to give reasons for the lemmings' strange behavior.

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Life Cycles
OUTCOME: 17. Compare the life cycles of plants and animals.

Background

The following information on the life cycles of specific plants and animals is needed for content accuracy when checking the activities suggested for the outcome listed.

One-celled animals, such as the amoeba, the paramecium, and the euglena, divide into two smaller cells and separate. This is called fission.

Some coelenterates, such as hydra or sponges, grow buds on the body. The buds grow and develop into tiny animals like the adults. Finally, they separate from the adult.

Insects such as the butterfly, moth, bee, ant, and fly undergo a complete metamorphosis which includes the egg, larva stages, pupa, and adult. Insects such as the grasshopper, dragonfly, cricket, and termite undergo an incomplete metamorphosis which includes the egg, nymph, and adult stages. Some spiders lay eggs in a cocoon. The eggs hatch inside, and the tiny spiders feed on other tiny spiders. When the surviving spiders grow larger, they leave the cocoon.

Crayfish, lobsters, crabs, and shrimp hatch from eggs that are attached to the female's first five pairs of spinnerets on her abdomen. The young remain attached to the female for two weeks after hatching. Then they leave the female and grow into adults. During the growth process the organism sheds its skin several times. This is called molting.

Most female fish lay their eggs in water where the male fertilizes them. The eggs hatch into tiny fish that develop like the adults. A few tropical fish, like the guppy, molly, or swordtail, bear their young alive.

Some reptiles deposit tough-shelled eggs in sandy soil. The heat of the sun helps the eggs to hatch. Young reptiles resemble the adults.

Amphibians such as frogs are hatched from eggs that have been deposited in water. These eggs change into tadpoles. The tadpoles later grow back legs. Finally, the front legs appear and lungs are formed. The tail disappears, and the frog grows into an adult.

OUTCOME 17 (Continued)
Background (Continued)

Birds lay eggs with hard shells. Adult birds sit on eggs from ten to fifty days, depending on the size of the bird. Baby birds have fluffy down feathers. They grow into adults.

Mammals are warm-blooded, air-breathing animals with backbones and bodies having hair. They are the only animals that produce milk to feed their young. Mammals bear live young.

Algae are simple plants that live independently or in colonies. Some algae reproduce by fission; others reproduce by spores or sexually by garnetes.

Ferns produce tiny cells called spores on the underside of the fronds. The spores fall to the moist ground and grow.

Molds grow filaments called hyphae. The hyphae grow a capsule called a sporangium. The sporangium contains thousands of spores. Spores are generated by various methods. They later grow into molds.

Yeast are one-celled fungi that reproduce by budding. When conditions are favorable, a little bud or knob pushes out of the side of a yeast cell. The bud grows rapidly and then breaks away to become a new yeast cell.

Mushrooms produce and release spores. The spores grow and produce hyphae (root-like filaments) under the surface of the soil. This pushes upward to form a small cap. The cap is supported by the stalk. On the underside of the cap are fleshy plates called gills. The gills produce more spores.

Gymnosperms are non-flowering plants that produce seeds enclosed in cones. The seeds drop to the ground and grow into young plants. If conditions are favorable, the young plant grows into a mature plant.

Angiosperms are flower-bearing plants. As the seeds develop, they are covered with seed coats or fruits. The seeds are dropped to the ground and sprout if conditions are favorable. The seed develops into a young plant. The plant matures and produces a flower. The flower forms either seeds in seed coats or seeds in a fruit.

It is recommended that the handout LIFE CYCLE MATCH-UP be given after the students show and explain their life-cycle mobiles.

OUTCOME 17 (Continued)

Materials

For each student:
- Handout: LIFE CYCLE MATCH-UP GAME
- Plates, paper
- Paper, construction
- Glue
- Scissors
- Pencils
- String or yarn
- Paper punch
- Resource books
- Crayons or markers

Procedures

Part A. Making a mobile of a life cycle

1. Assign each student a plant or animal to research. Tell the student to find information about the life cycle of the plant or animal. Be sure to assign the following: Mushrooms, Yeast, Dogwood, Amoeba, Spider, Grasshopper, Butterfly, Frog, Pine Tree, Shrimp, Alligator, and Birds.

   Examples of plants and animals to be researched:

   a. Butterfly
   b. Moth
   c. Bee
   d. Ant
   e. Fly
   f. Grasshopper
   g. Dragonfly
   h. Cricket
   i. Termite
   j. Spider
   k. Tick
   l. Scorpion
   m. Frog
   n. Toad
   o. Newt
   p. Salamander
   q. Alligator
   r. Crocodile
   s. Turtle
   t. Lizard
   u. Bird
   v. Crayfish
   w. Lobster
   x. Crab
   y. Shrimp
   z. Hydra
   aa. Sponge
   bb. Amoeba
   cc. Paramecium
   dd. Euglena
   ee. Algae
   ff. Fern
   gg. Yeast
   hh. Mushroom
   ii. Evergreen tree
   jj. Deciduous tree
   kk. Any flower-bearing plant
   ll. Any mammal

2. Direct the students to sketch the stages of the life cycle of the assigned plant or animal on a sheet of paper.

OUTCOME 17 (Continued)
Procedures (Continued)

3. Direct the students to make a mobile using paper plates tied together to make a mobile of the life cycle they have sketched.

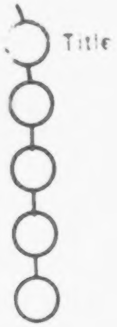
4. Tell the students to draw the stages on construction paper and use markers to show details in the drawings. Ask students to draw the stages large enough to cover the center of the paper plates.

5. Direct the students to cut out their drawings and glue them to the center of the paper plates.

6. Ask the students to label each plate with a few words that describe the stage.

7. Direct the students to make a title plate.

8. Direct the students to punch a hole in the top and bottom of each plate and then tie the plates together with string or yarn.



9. Have the students to show their mobiles to the class and explain the life cycle of their plants or animals.

10. Hang the mobiles in the room or hallway.

Part B. Playing LIFE CYCLE MATCH-UP GAME

1. Distribute the handout LIFE CYCLE MATCH-UP GAME to each student.

2. Tell the students to follow the directions on the handout LIFE CYCLE MATCH-UP GAME.

Extensions

1. Collect frog eggs and watch the stages of development. Draw pictures of stages observed.

OUTCOME 17 (Continued)
Extensions (Continued)

2. Locate information about the Surinam "toad" (frog) and present as part of a class discussion.

3. Plant a seed and watch it grow. Record daily observations in a journal.

LIFE CYCLE MATCH-UP GAME
Handout

Directions:
1. Cut out the squares.
2. Glue on paper the numbered squares first.
3. Match the other squares to the proper plant or animal.
   Hint: Use the life cycle mobiles to help you place them correctly.

4. Mushrooms	Egg, nymph, and adult Incomplete Metamorphosis	13. Yeast	Lay tough-shelled eggs in soil. Sun helps eggs to hatch. Young look like adults	11. Dogwood tree
Egg, larva, and adult Complete Metamorphosis	8. Amoeba	10. Spider	5. Grasshopper	One-celled animal that divides into two cells and splits.
3. Butterfly	2. Frog	1. LIFE CYCLE MATCH-UP GAME	6. Pine Tree	Angiosperms are flower-bearing plants. Flowers produce seeds.
12. Shrimp	7. Alligator	Eggs change into tadpoles. Tadpoles lose legs and tails. Lungs develop.	Young hatch from eggs and remain attached to female's spinnerets.	9. Birds
Lay eggs with hard shells. Adult sits on eggs to hatch.	Lay eggs in a cocoon. Eggs hatch inside cocoon. Young look like adults.	One-celled fungus that grows a bud. The bud breaks away and grows into an adult.	Produce spores from caps. Caps are supported by the stalk.	Gymnosperms are non-flowering plants that produce seed in cones.

LIFE CYCLE MATCH-UP GAME
KEY

1. LIFE CYCLE MATCH-UP GAME	
2. Frog	Eggs change into tadpoles. Tadpoles lose legs and tails. Lungs develop.
3. Butterfly	Egg, larva, pupa and adult Complete Metamorphosis
4. Mushrooms	Produce spores from caps. Caps are supported by the stalk.
5. Grasshopper	Egg, nymph, and adult Incomplete Metamorphosis
6. Pine Tree	Gymnosperms are non-flowering plants that produce seed in cones.
7. Alligator	Lay tough-shelled eggs in soil. Sun helps eggs to hatch. Young look like adults.
8. Amoeba	One-celled animal that divides into two cells and splits. Grows to adult size.
9. Birds	Lay eggs with hard shells. Adult sits on the eggs to hatch.
10. Spider	Lay eggs in a cocoon. Eggs hatch inside cocoon. Young look like adults.
11. Dogwood Tree	Angiosperms are flower-bearing plants. Flowers produce seeds.
12. Shrimp	Young hatch from eggs and remain attached to female's spinnerets.
13. Yeast	One-celled fungus that grows a bud. The bud breaks away and grows into an adult.

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Need For Food and Oxygen
OUTCOME: 18. Explain why living things must have food and oxygen to survive.

Background

Living things need food and oxygen to survive. Living things are made of cells. Within a living cell, oxygen is used to burn the digested food. This burning produces heat and energy and releases carbon dioxide. The energy that is released is used to perform the actions necessary for life. Reproduction and growth of cells, digestion of food, repair of cells, energy release, waste removal, and movement are some of the life processes that are necessary for survival.

The following activity will use the yeast cell to demonstrate that living things need food and oxygen to survive. Five experiments will be planned. Separate the experiment cards so that each group will have a different experiment. Some yeast cells will receive food and some will not. This activity will take sixty minutes to complete.

Materials

For each group:
- Salt
- Sugar
- Honey
- Syrup
- Yeast, dry (package)
- Balloons
- Soda bottle, small
- Water, warm
- Handout: EXPERIMENT CARDS
- Handout: GROWTH AND MAINTENANCE

Procedures

Part A

1. Show pictures of living and non-living things. Ask the students to identify the living things. Ask the students to explain how they know these things are living. (They are living because they grow, reproduce, move, digest food, and get rid of waste. These are some of the life processes.)

Procedures (Continued)

2. Ask the students to tell how the living things are alike. (They are made of cells. They grow, reproduce, digest food, and get rid of waste.)

3. Ask the students to tell how the living things are different. (Some are plants, some are animals, some are large, and some are small.)

4. Ask the students to tell what all of these living things need to stay alive. (Water, food, and oxygen.)

5. Tell the students to copy the following information from the board:

   a. Digest food (Green plants make their own food.)
   b. Release energy - respiration
   c. Get rid of waste
   d. Grow
   e. Reproduce

6. Tell the students that food and oxygen are necessary for these life processes to be carried out by living things or organisms.

Part B

1. Divide the class into five small groups.

2. Distribute to each group one of the experiment cards with printed directions and materials.

3. Tell each group to be prepared to explain the procedures, results, and conclusions after the experiment has been conducted.

4. Instruct each group to conduct its experiment.

5. Have each group present its report to the class.

6. Direct the students to complete the handout GROWTH AND MAINTENANCE after each experiment is presented.

EXPERIMENT CARDS
Handout

Experiment A

1. Label the bottle "A."

2. Place 1/2 cup of warm water and a package of yeast in the bottle and stir.

3. Put a balloon over the mouth of the bottle.

4. Observe.

Experiment B

1. Label the bottle "B."

2. Place 1/2 cup of warm water, a package of yeast, and 2 tablespoons of salt in the bottle. Stir.

3. Place a balloon over the mouth of the bottle.

4. Observe.

EXPERIMENT CARDS
Handout (Continued)

Experiment C

1. Label the bottle "C."

2. Place 1/2 cup of warm water, a package of yeast, and 2 tablespoons of sugar in the bottle. Stir.

3. Place a balloon over the mouth of the bottle.

4. Observe.

Experiment D

1. Label the bottle "D."

2. Place 1/2 cup of warm water, a package of yeast, and 2 tablespoons of syrup in the bottle. Stir.

3. Place a balloon over the mouth of the bottle.

4. Observe.

EXPERIMENT CARDS
Handout (Continued)

Experiment E

1. Label the bottle "E."
2. Place 1/2 cup of warm water, a package of yeast, and 2 tablespoons of honey in the bottle. Stir.
3. Place a balloon over the mouth of the bottle.
4. Observe.

GROWTH AND MAINTENANCE
Handout

1. Experiment A. What do you observe? Sketch what you see. Why do you think this happened?

2. Experiment B. What do you observe? Sketch what you see. Why do you think this happened?

3. Experiment C. What do you observe? Sketch what you see. Why do you think this happened?

4. Experiment D. What do you observe? Sketch what you see. Why do you think this happened?

5. Experiment E. What do you observe? Sketch what you see. Why do you think this happened?

6. What things were kept the same (controlled) in the five experiments?

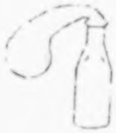
7. Why do you think the balloons expanded in Experiments C, D, and E?

8. What did the yeast cells need in order to grow and survive?

GROWTH AND MAINTENANCE
Key

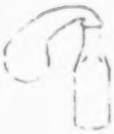
1. Experiment A. What do you observe? Sketch what you see. Why do you think this happened?

(The balloon did not expand. The yeast did not grow because there was no food added to the yeast and water; therefore, no carbon dioxide was given off.)



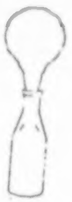
2. Experiment B. What do you observe? Sketch what you see. Why do you think this happened?

(The balloon did not expand. The salt was not food for the yeast; therefore, the yeast did not grow and carbon dioxide was not released.)



3. Experiment C. What do you observe? Sketch what you see. Why do you think this happened?

(The balloon expanded. Sugar was used for food by the yeast cells, and they grew and divided. Carbon dioxide was released by the process, and the carbon dioxide caused the balloon to expand.)



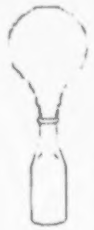
4. Experiment D. What do you observe? Sketch what you see. Why do you think this happened?

GROWTH AND MAINTENANCE
Key (Continued)

(The balloon expanded. Syrup supplied the yeast cells with food, and the yeast divided. Growth took place, and carbon dioxide was released into the balloon.)

5. Experiment E. What do you observe? Sketch what you see. Why do you think this happened?

(The balloon expanded. Honey was used by the yeast cells as food for growth. Carbon dioxide filled the balloon.)



6. What things were kept the same (controlled) in the five experiments?

(Warm water, yeast, a bottle, and a balloon were used in the five experiments.)

7. Why do you think the balloons expanded in Experiments C, D, and E?

(The yeast produced a waste gas called carbon dioxide as it used its food to grow. The carbon dioxide was released into the balloon and caused the balloon to expand.)

8. What did the yeast cells need in order to grow and survive?

(Food and oxygen were needed for growth and survival. The yeast cells also needed warm water.)

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Need for Food and Oxygen
OUTCOME: 19. Explain how green plants make food.

Background

The leaves of green plants make food from carbon dioxide, water, and energy from the sun. This process is called photosynthesis. The plant stores the food as starch. Water dissolves the minerals in the soil and travels into the roots, up the stem, and into the leaves. Carbon dioxide enters the leaves through tiny openings called stomata on the underside of the leaves.

Green-colored materials in the leaves called chlorophyll help the carbon dioxide and water form a food called glucose (sugar) and a gas called oxygen. The leaf changes this glucose into starch. Some sugar is changed into fats and proteins. These foods are sent to roots and the stem for use or storage. The oxygen passes out of the stomata into the air. NOTE: In the respiration process, green plants ingest oxygen to release energy and exude carbon dioxide. Plants also expel oxygen; therefore, there is a surplus of oxygen to be used by other organisms.

Emphasize the following safety cautions to students:

a. No part of a plant used in the experiment should be placed in the students' mouths.

b. Students should never inhale or expose the skin or eyes to a burning plant.

c. Students and the teacher should be extra cautious when dealing with fire. Potential hazards should be pointed out to students. Precautions to be taken should be discussed.

Materials

- Plant, healthy
- Water
- Alcohol
- Double boiler
- Hot plate
- Paper towels (1 roll)
- Iodine (1 bottle)

For each group:
- Saucer(s) (1 or 2)

OUTCOME 19 (Continued)

Procedures

1. Place several plants in the sun for several hours.

2. Emphasize to the students the important roles of energy from the sun, water, and carbon dioxide in the making of food for green plants. Inform students that this process is called photosynthesis.

3. Discuss with the students the importance and function of chlorophyll (green colored materials) found in the leaves of green plants. Refer to the background information.

4. Divide the class into small groups.

5. Remove enough leaves for each group to have several and place them in a boiler over a hot plate.

6. Boil the leaves in the water for a few minutes to break down the cell walls of the leaves.

7. Remove the leaves from the boiler and place them in the top of a double boiler.

8. Add rubbing alcohol to the top of the double boiler and heat the solution to the boiling point. Boil for ten to fifteen minutes until most of the chlorophyll is removed.

9. Remove the leaves from the alcohol and rinse in hot water. Blot gently with a paper towel.

10. Distribute several leaves to each group of students. Have the students examine the leaves and place them on a saucer.

11. Drop a few drops of iodine on the leaves that have been distributed to each group.

12. Have groups observe what happens and discuss the changes that occurred within the leaves.

13. Explain to the students that the dark blue color shows the presence of starch. Remind students of the photosynthesis process and the specific function of the starch.

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Need for Food and Oxygen
OUTCOME: 20. Explore the role of green plants in the production of oxygen.

Background

Green plants use the energy of the sun and chlorophyll to combine carbon dioxide and water to form sugar, called glucose; and a gas, called oxygen. This process is called photosynthesis. Sugar is stored as starch in plants, and oxygen is released through openings in leaves. Oxygen is produced as a by-product of photosynthesis. The following experiment will take approximately five days and will demonstrate the production of oxygen as a by-product of photosynthesis. Elodea or sagillaria, a water plant, can be purchased at a store that sells aquarium equipment.

Materials

- Live water plant, Elodea or Sagillaria
- Funnel, plastic
- Test tube
- Aquarium
- Splint or long wooden match

For each student:
- Handout: OBSERVATIONS AND TESTING FOR OXYGEN

Procedures

Part A. Demonstration of oxygen released during photosynthesis (Takes approximately five days.)

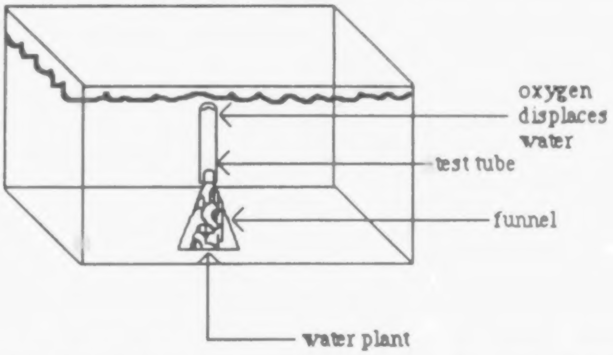
1. Ask a student to place an aquarium in a sunny place.

2. Tell the student to fill the aquarium with water.

3. Direct the student to place a water plant at the bottom of the aquarium and cover the plant with a funnel.

OUTCOME 20 (Continued)
Procedures (Continued)

4. Ask the student to fill a test tube with water. Tell the student to invert the test tube over the stem of the funnel. (See illustration.)



5. Distribute the handout OBSERVATIONS AND TESTING FOR OXYGEN and direct the students to answer questions 1 and 2 on the handout.

6. Ask the students to make observations each day and record their findings.

Part B. Demonstration of test for oxygen
(Complete this on the fourth or fifth day.)

1. On the fourth or fifth day, remove the test tube and hold its mouth up.

2. Place an ignited splint into the test tube.

3. Ask the students to observe what happens.

4. Direct them to record their answers for questions 7, 8, 9, and 10.

OBSERVATIONS AND TESTING FOR OXYGEN
Handout

Part A - Observations

1. What do you predict will happen in the experiment?

Day One

2. What changes do you observe?

Day Two

3. What changes do you observe?

Day Three

4. What changes do you observe?

Day Four

5. What changes do you observe?

6. What do you predict is forming in the test tube?

Part B - Testing for Oxygen

7. What happened to the ignited splint when it was placed into the test tube?

8. Why?

9. What do you conclude from experiment?

10. Why do you think the aquarium was placed in a sunny place?

OBSERVATIONS AND TESTING FOR OXYGEN
Key

Part A - Observations

1. What do you predict will happen in the experiment?
   (Oxygen will fill the test tube.)

Day One

2. What changes do you observe?
   (None)

Day Two

3. What changes do you observe?
   (Water plant is transmitting bubbles.)

Day Three

4. What changes do you observe?
   (Water plant is transmitting bubbles. Bubbles have displaced some of the water in the test tube.)

Day Four

5. What changes do you observe?
   (Bubbles have displaced water.)

6. What do you predict is forming in the test tube?
   (Oxygen.)

Part B - Testing for Oxygen

7. What happened to the ignited splint when it was placed into the test tube?
   (The splint glows more brightly or bursts into flames.)

8. Why?
   (The oxygen in the test tube was pure oxygen. It was not mixed with other gases in the air. The spling burst into flame.)

9. What do you conclude from experiment?
   (The water plant released oxygen into the test tube during photosynthesis.)

10. Why do you think the aquarium was placed in a sunny place?
    (Photosynthesis will not occur if the plant does not receive light energy.)

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Digestive System
OUTCOME: 21. Discuss organs of the digestive system and how they work together.

Background

The digestive system has two divisions: the alimentary canal that begins at the mouth and ends at the rectum, and the digestive glands (agents that help to break down food.) The alimentary canal includes the mouth, the throat (pharynx), the esophagus (gullet), the stomach, the small intestine, and the large intestine.

The digestive organs and glands include the salivary glands, the liver, the pancreas, the gastric glands of the stomach, and the intestinal glands of the small intestine. These glands produce juices that enter the alimentary canal through ducts or small tubes. These juices contain enzymes which are powerful chemicals that break food into smaller and simpler forms.

Materials

- Textbooks or reference books showing digestive system
- Butcher paper, white (1 roll)
- Scissors (several)
- Paper

For each student:
- Cracker
- Markers
- Pencils
- Handout: DIAGRAM OF THE DIGESTIVE SYSTEM

Procedures

Part A. Following food through the digestive system and locating organs of this system

1. Inform students that the process of changing food into a state that the body can use is called digestion.

2. Discuss with students the process that occurs during digestion. Distribute and direct the students to use the handout DIAGRAM OF THE DIGESTIVE SYSTEM. Have students chart a piece of food as it moves through the body. (As the food moves through the body, it goes from one organ to another.) Ask the students to label the organs as the process of digestion is discussed.

OUTCOME 21 (Continued)
Procedures (Continued)

3. Give each student a cracker. Tell the students to take a bite. Ask the students to describe the digestive process that occurs in the mouth. Locate the mouth on the diagram.

4. Tell students that as they bit into their crackers a chemical process began that involved the teeth, the salivary glands, and the throat. Explain this process to students using the diagram of the digestive system.

5. Direct the students to take another bite of the cracker and chew it. Direct the students to put their hands to their throats and feel this movement. Explain to students that muscles in the esophagus squeeze the cracker down the esophagus and into the stomach.

6. Explain to the students that the food stays in the stomach two to five hours. Demonstrate where the stomach is found. Direct students to locate their stomachs. Point out the esophagus and the stomach on the diagram.

7. Describe the digestive process involving the stomach and intestine. Locate these organs on the diagram.

8. Inform the students that the small intestine is about twenty-three feet long. Explain that it is coiled around inside the abdomen or part of the body that contains the digestive organs. Locate the abdomen on the diagram. Tell students that as the food enters the small intestine, digestive juices (bile from the liver and pancreatic juice from the pancreas) enter the intestine at the same time. Locate the liver and the pancreas on the diagram. Describe this process in detail to include the following information: Intestinal juices (produced by the small intestine) and pancreatic juices contain enzymes (strong chemicals that break down food). The bile from the liver breaks fats into small droplets, and the enzymes from pancreatic juices attack the droplets and digest them. Enzymes from these digestive juices work together to digest carbohydrates, fats, and proteins. These digested substances are changed into simpler substances that can be used by the cells of the body.

OUTCOME 21 (Continued)
Procedures (Continued)

9. Inform the students that in the small intestine, digestion is completed. Tell them that the small intestine liquidizes the food, and the food passes through the walls of the small intestine by way of villi (fingerlike projections located on the walls of the small intestine). Explain that the food passes into the blood stream and is carried to all parts of the body.

10. Inform the students that some of the food is not usable and is called waste. Locate the large intestine on the diagram. Tell the students that the large intestine is about five feet long. Emphasize that waste passes through the large intestine in about two days and is removed from the body as a bowel movement. The large intestine also removes water from the waste material.

11. Tell the students to compare their lists of digestive organs. Have them use a reference book to check their lists.

Part B. Making models of the digestive system

1. Assign the students to pairs.

2. Direct the students to cut butcher paper longer than the length of their bodies.

3. Instruct one student to lie down on the paper while the other student traces around his or her body with a pencil. Instruct him or her to trace the outline with a black marker. Ask the students to exchange places and repeat the same procedures.

4. Suggest to the students that they use their lists of digestive system organs and reference books to help them sketch the organs of the digestive system. Instruct them to use colored markers to identify the organs. Have them label the organs on the drawings of their bodies.

Extension

Direct each student to write a creative story about a cracker as it moves through the digestive system. Ask the students to read their stories.

DIAGRAM OF THE DIGESTIVE SYSTEM
Handout

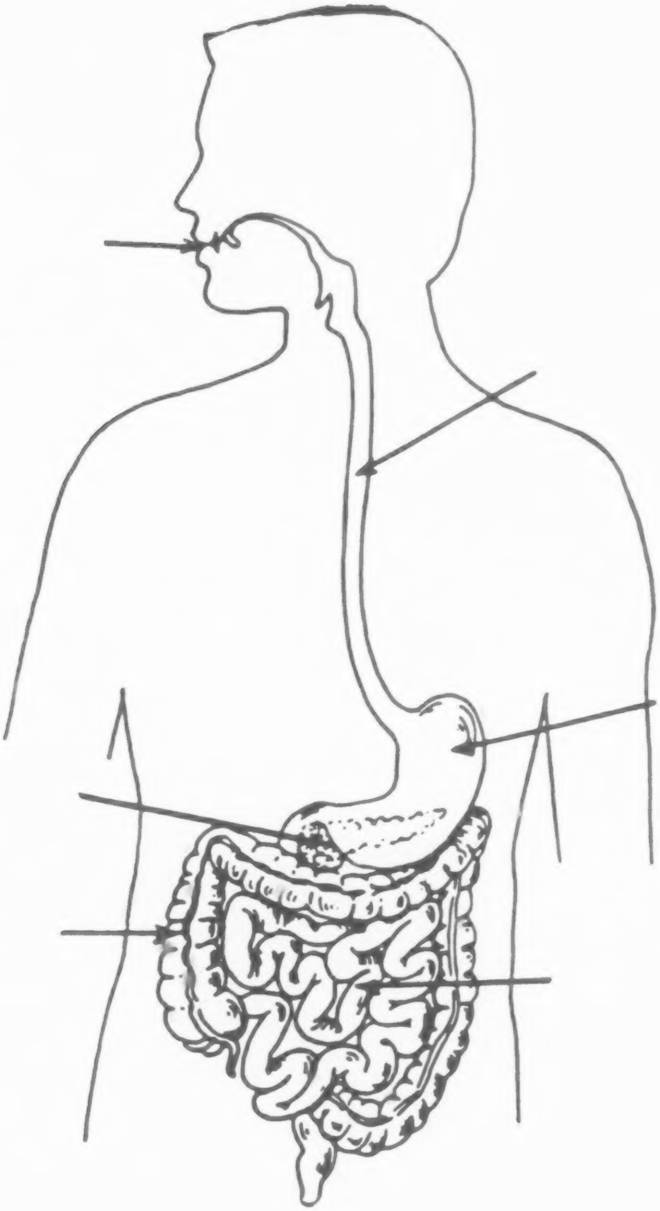
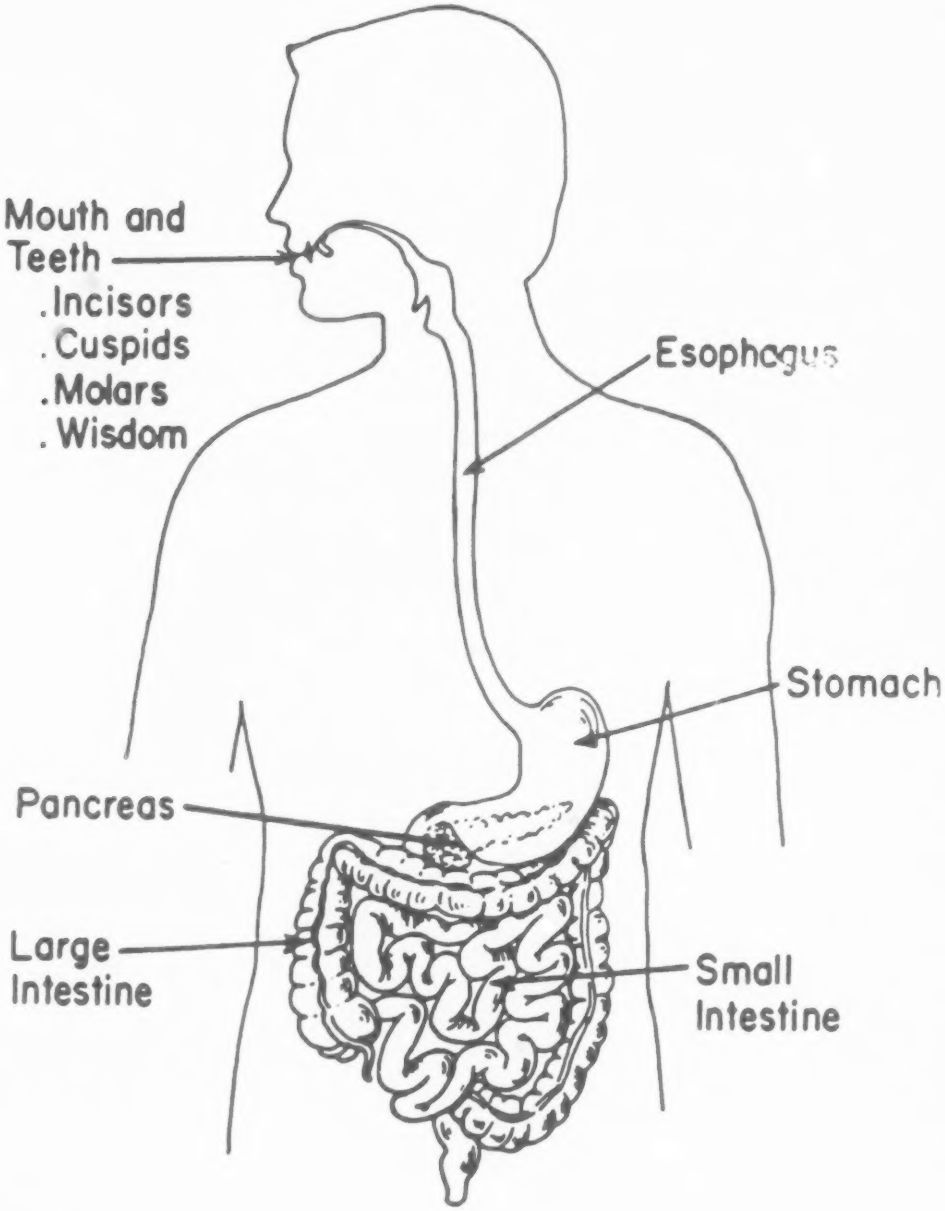


DIAGRAM OF THE DIGESTIVE SYSTEM
Key


Mouth and Teeth
.Incisors
.Cuspids
.Molars
.Wisdom
Esophagus
Stomach
Pancreas
Large Intestine
Small Intestine

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Digestive System
OUTCOME: 22. Discuss digestion and effects of enzymes on food.

Background

Digestion is the process by which foods are changed so that they can be used by the body. Foods are digested by two processes: physical grinding like chewing, mashing, and churning, and chemical breakdown by digestive juices. Enzymes are found in some digestive juices. They are found in saliva, gastric stomach juices, pancreatic juices, and intestinal juices. An enzyme is a powerful chemical that acts on the food and breaks it into simpler forms which can be digested more easily.

An enzyme that breaks down protein is present in meat tenderizer and fresh pineapple juice. This enzyme prevents gelatin from setting. Digestive enzymes are powerful chemical substances that break down nutrient molecules into smaller soluble molecules.

Materials

For each group:
- Cups (2)
- Water
- Pineapple, fresh (1 oz.)
- Gelatin (1 pkg.)

Procedures

Part A

1. Explain to the students that food is digested by chemical substances called enzymes. Tell students that enzymes are in saliva, stomach juices, pancreatic juices, and intestinal juices.

2. Discuss with the students ways by which food is broken down.

3. Tell the students that fresh pineapple juice or meat tenderizers can break down protein and that gelatin is a form of protein.

OUTCOME 22 (Continued)
Procedures (Continued)

Part B

1. Divide the class into groups.
2. Ask each group to make one cup of gelatin using water as directed on the gelatin package. Monitor group activity.
3. Direct the students to make a second cup of gelatin but to substitute one ounce of fresh pineapple juice for one ounce of the required water.
4. Direct the students to mark the cups "P" for plain or "PJ" for pineapple juice. Have each group to label its cups.
5. Tell the students to place the gelatin in a refrigerator.
6. Ask the students to predict the outcome of this demonstration.
7. After several hours, have students collect the cups. Have the students examine the results. Explain to the students that the cup with the enzyme (pineapple juice) does not set because the pineapple juice dissolves the gelatin.

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Digestive System
OUTCOME: 23. Explain the processes of diffusion and osmosis.

Background

Diffusion is the movement of molecules from an area of higher concentration to an area of lesser concentration. The process continues to occur until the areas are equalized. A special type of diffusion is osmosis. Osmosis can cause a cell to swell or to shrink, depending on the amount of water around the cell. Molecules pass through semipermeable membranes that allow water and other small molecules such as sugar to move through them. Proteins and other large molecules must be broken down into smaller parts to pass through the cell membrane.

The body continually uses sugar. Sugar molecules diffuse through the cell membrane because there is less sugar inside the cells than on the outside. Cells constantly produce waste. Waste diffuses out of the cell membrane because there is less waste outside the cell than inside the cell. Blood carries waste away and allows more waste to diffuse out of the cells.

Materials

For each group:
- Plastic glass, clear
- Coffee filters (2)
- Water
- Salt
- Egg yolks (2)
- Plastic bowls, small (2)
- Rubber bands
- Food coloring, any color
- Spoon for stirring

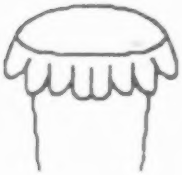
Procedures

Part A. Observation of diffusion of ink molecules

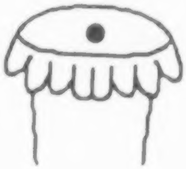
1. Assign students to groups.

OUTCOME 23 (Continued)
Procedures (Continued)

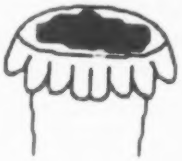
2. Ask students to fill a plastic glass with water and cover the top of the glass with a coffee filter.



Stage 1



Stage 2



Stage 3

3. Tell the students to secure the coffee filter with a rubber band.

4. Direct the students to place a drop of food coloring on the coffee filter and observe what happens.

5. Direct the students to summarize, in writing, the results of the experiment.

6. Direct the students to include a definition of diffusion within the summary.

Part B. Observation of diffusion of water in and out of a cell

1. Tell students to remain in groups assigned.

2. Ask students to fill two plastic bowls with water, and to stir salt into one of the bowls of water.

3. Direct the students to place an egg yolk into the salt water and observe. Tell students to notice how the egg that is floating in salt water is shrinking because the egg cell's cytoplasm has more water than the egg cell's salty surrounding.

4. Explain to the students that osmosis is occurring because water is moving from the egg cell into the salt water, causing the egg to shrink.

5. Ask the students to place an egg yolk into the bowl filled with regular tap water and observe. Ask the students to notice how the egg floating in the water is swelling.

OUTCOME 23 (Continued)
Procedures (Continued)

6. Tell the students that the egg is swelling because the egg cell's cyctoplasm has less water than the egg cell's surroundings, and water is moving by osmosis into the egg cell.

7. Ask the students to define osmosis and explain what happened to the egg cells in the experiments.

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Digestive System
OUTCOME: 24. Explain that digested food is utilized in each cell.

Background

Not everything that we eat is an energy source. Proteins, carbohydrates (sugars and starches), and fats supply energy. Proteins break down into amino acids. Carbohydrates break down into simple sugars. Fats break down into fatty acids. Amino acids, simple sugars, and fatty acids are absorbed into the blood strem and transported to the many cells of the body. Inside the cell (in the cytoplasm), the simple sugars break down into pyruvic acid. The amino acids, fatty acids, and pyruvic acid enter the mitochondria. There, these acids are acted upon by enzymes in the presence of oxygen and chemical changes. The result is the formation of ATP molecues (adenosine triphosphate), carbon dioxide, and water. The ATP molecules then return to the cytoplasm of the cell where they serve as stored energy. When the cell needs energy, the ATP molecules break down by cellular enzymes, and energy is released.

A raw egg is used to demonstrate the cell membrane, nucleus, and cytoplasm. The mitochondria and vacuoles (storage spaces) are structures inside the cytoplasm. A handout is used to show what happens in the cell. An analogy is used to show the students that the cell is similar to a factory.

Materials

- Scissors
- Paper, construction
- Pie plate, glass
- Raw egg
- Overhead projector
- Screen
- Handout: FACTORY

Procedures

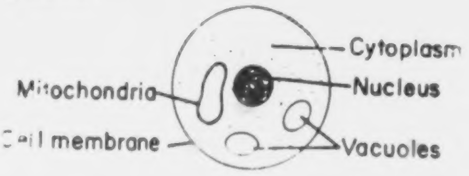
1. Break a raw egg into a glass pie plate.

2. Place the plate on the overhead projector.

OUTCOME 24 (Continued)

Procedures (Continued)

3. Project the image on the screen.
4. Ask the students to draw the image on paper.
5. Tell the students that the yolk represents the nucleus, the white of the egg represents the cytoplasm where food is stored and the outer edge of the egg represents the cell membrane. Explain to the students that the cell membrane allows food and oxygen to pass through it. Tell the students to label these parts.



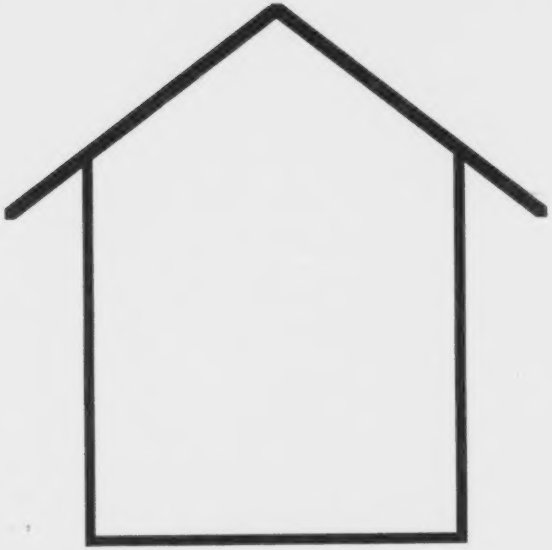
6. Tell the students there are two other structures in the cytoplasm. Tell them there are vacuoles that store food and there are mitochondria where the food is acted upon by enzymes and oxygen. In the mitochondria, a chemical change takes place and ATP molecules (the energy source), carbon dioxide, and water are transmitted. Tell them to add these two structures on their drawings and label the parts.
7. Direct the students to add these structures to the egg cell image. (Use shapes cut out of paper to place on the white of the egg to show mitochondria and vacuoles.) Refer to illustration shown in procedure number five.
8. Tell the students that our body's energy comes from the chemical action that takes place in the mitochondria of the cell. The chemicals involved in this action come from amino acids (broken-down proteins), fatty acids (broken-down fats), and simple sugars (broken-down carbohydrates.) The amino acids, fatty acids, and simple sugars pass through the cell membrane into the cytoplasm. They combine with oxygen and burn (oxidize). The burning creates energy which forms a chemical called ATP. ATP is then stored in the vacuoles (storage holes) in the cytoplasm. When the cell needs energy, the ATP breaks down into tiny explosions or releases of energy. Carbon dioxide and water are by-products and leave the cell.

OUTCOME 24 (Continued)
Procedures (Continued)

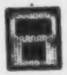
9. Explain to students that the cell is similar to a factory. The factory has a furnace that burns wood. First, the logs must be cut small enough to fit into the furnace. The small pieces of wood and oxygen in the furnace burn to heat water and produce steam. The steam turns the blades of a turbine, a device that is made up of a wheel and blades. The turbine is attached to a generator, which is a magnet inside a coil of wire. When the turbine moves, it turns a magnet which produces an electric current inside the coil of wire. Electrical energy is produced.

10. Distribute the handout FACTORY and explain the directions to the students.

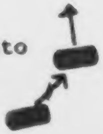
FACTORY
Handout



1. Draw the furnace in the factory.

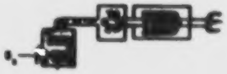


2. Place an arrow showing wood going into furnace.



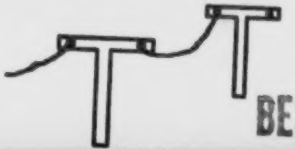
3. Show oxygen going into furnace. O_2

4. Show steam moving through a pipe from the furnace to a turbine which is attached to the generator.



5. Show electricity being produced by the generator. ε

6. Show electrical poles with wires to represent electricity being used.



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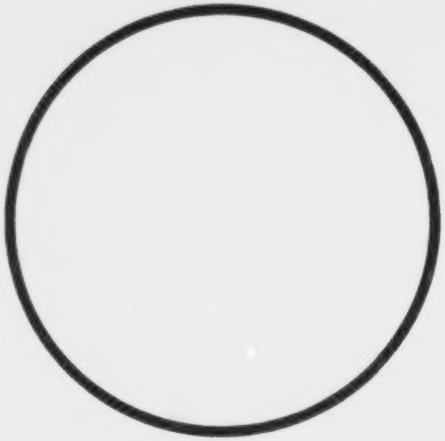
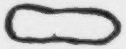


Cell

1. Draw the mitochondria in the cell.

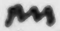


2. Draw the vacuoles in the cell.

3. Place an arrow showing food (fatty acids ☁, amino acids and simple sugars □) through the cell membrane.

4. Using arrows show the fatty acids, ☁ amino acids △ and pyruvic acids ▯ ▯ entering the mitochondria.

5. Show the oxygen O_2 ↗ entering the cell membrane, entering the cytoplasm, and continuing into the mitochondria.

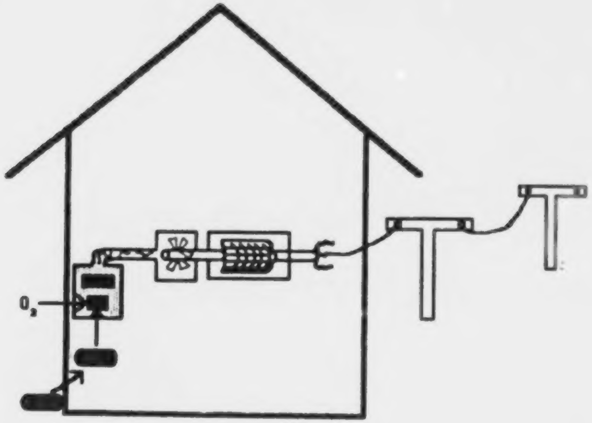
6. Add  to represent the burning of the food and oxygen.

7. Add ATP to show the chemical energy that is formed.

8. Show ATP moving to the vacuoles to be stored until the cell needs energy. (ATP)

9. Show water (H_2O) and carbon dioxide (CO_2) leaving the

FACTORY
Key

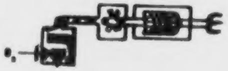


1. Draw the furnace in the factory.

2. Place an arrow showing wood going into furnace.

3. Show oxygen going into furnace. O_2

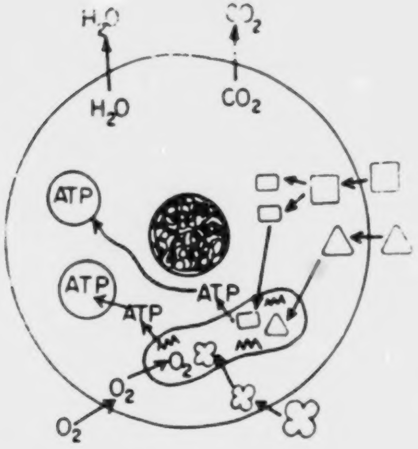
4. Show steam moving through a pipe from the furnace to a turbine which is attached to the generator.



5. Show electricity being produced by the generator. ε

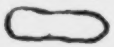
6. Show electrical poles with wires to represent electricity being used.

BEST COPY AVAILABLE



Cell

1. Draw the mitochondria in the cell.



2. Draw the vacuoles in the cell.

3. Place an arrow showing food (fatty acids ☁, amino acids and simple sugars □) through the cell membrane.

4. Using arrows show the fatty acids, ☁ amino acids △ and pyruvic acids ▯ ▯ entering the mitochondria.

5. Show the oxygen O_2 ↗ entering the cell membrane, entering the cytoplasm, and continuing into the mitochondria.

6. Add 〰 to represent the burning of the food and oxygen.

7. Add ATP to show the chemical energy that is formed.

8. Show ATP moving to the vacuoles to be stored until the cell needs energy.

9. Show water (H_2O) and carbon dioxide (CO_2) leaving the cell.

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Circulatory System
OUTCOME: 25. Discuss the organs of the circulatory system and how they work together.

OUTCOME: 26. Explain the function of blood.

Background

The circulatory system consists mainly of the heart and a network of blood vessels: arteries, veins, and capillaries (CAP-uh-ler-ees). The heart is muscle. Man's heart has four chambers: the right atrium, the right ventricle, the left atrium, and the left ventricle.

The heart, the center of the circulatory system, consists of two pumps that move blood through the body. The heart is located close to the center of the chest and is about the size of a fist. Arteries carry blood away from the heart; veins carry blood to the heart.

The heart works all the time. The pump on the left side of the heart pumps blood that contains nutrients and fresh oxygen to all tissues of the body through blood vessels called arteries.

As the blood is pumped through the body, it collects carbon dioxide and other waste materials that the body tissues cannot use. The arteries branch many times after they leave the heart. Gradually, the arteries become smaller and smaller until they form tiny blood vessels called capillaries. The task of delivering nutrients and oxygen to the tissues and collecting wastes is completed in the capillaries. As the blood moves through the capillaries, the blood vessels become larger and eventually become veins. The veins carry the blood through organs of the body such as the liver which removes some of the wastes. Then the veins carry the blood to the right side of the heart.

The pump on the right side of the heart pumps the blood to the lungs. The lungs remove the carbon dioxide (used oxygen) in the blood and absorb fresh oxygen. This blood containing fresh oxygen is pumped back into the left side of the heart and on through the arteries to all the tissues of the body.

OUTCOMES 25 and 26 (Continued)
Background (Continued)

The blood, the heart, and the blood vessels constitute the cardiovascular system. Blood performs several functions. It carries oxygen from the lungs to all cells of the body and carbon dioxide from the cells to the lungs. The blood also transports enzymes to various cells; nutrients from the digestive organs to the cells; waste products from the cells to the kidneys, the lungs, and the sweat glands; and hormones from the endocrine glands to the cells. When the skin is cut, blood cells rush to the surface of the skin to protect it from bacteria and dirt. Blood also plays a part in temperature regulation. Through clotting, it prevents the loss of body fluids. It serves all the tissues of the body. The main function of the blood is to repair damaged or worn-out cells and aid the growth of new cells.

It takes about one minute for the blood to circle all around the body. This process is called circulation. All the blood goes through the lungs and the heart during every trip around the body.

Materials

For each group:
- Rubber tubing, 30cm long (2), 10cm long (1)
- Y or T tube, glass
- Funnels, small (3)
- Handout: HOW TO MAKE A STETHOSCOPE

For each student:
- Handout: THE CIRCULATORY SYSTEM

Procedures

1. Distribute the handout THE CIRCULATORY SYSTEM. Explain how blood circulates through the body and the specific functions it performs.

2. Have students trace the movement of the blood through the body.

3. Divide the class into small groups. Explain to the students that each group is to make one stethoscope so that members in the group can listen to each other's heartbeat.

4. Explain that the sound which is heard is caused by the opening and closing of valves inside the heart. State that valves are like little doors that let blood in and out of the heart. Explain that when we hear a heartbeat, we know that the heart is working to pump the blood all around the body.

OUTCOMES 25 and 26 (Continued)

Procedures (Continued)

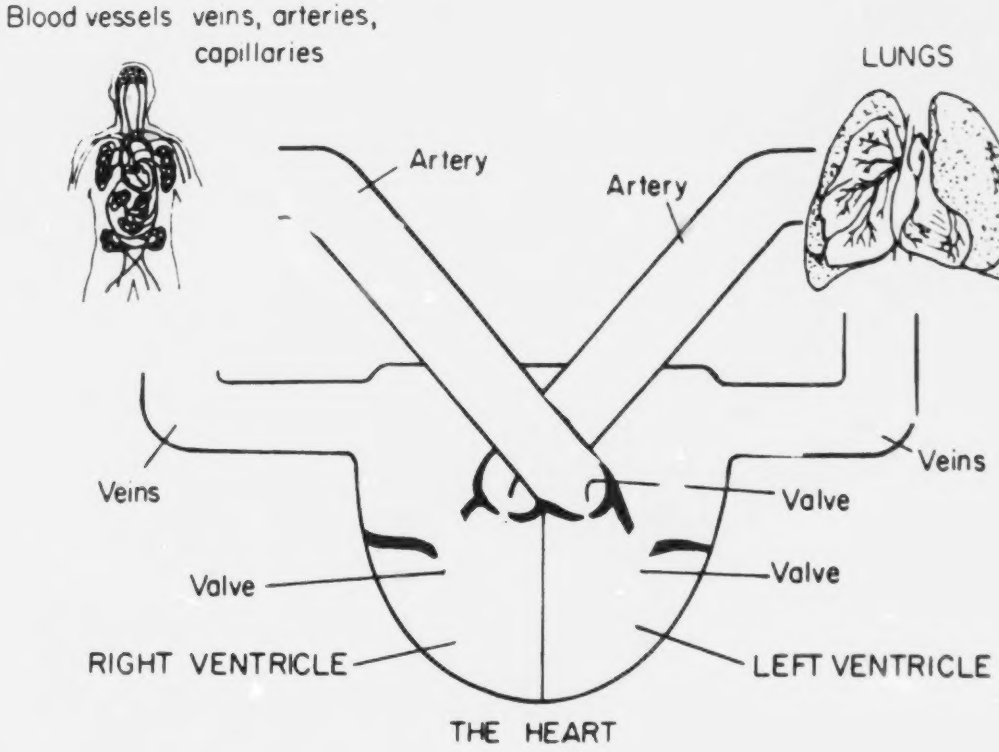
5. Distribute the handout HOW TO MAKE A STETHOSCOPE to each group. If necessary, demonstrate how to follow the directions given on the handout.

6. Explain that each student is to take turns holding the funnel firmly over his or her heart while another student holds the ends of the tubing to his or her ears to listen to the heartbeat.

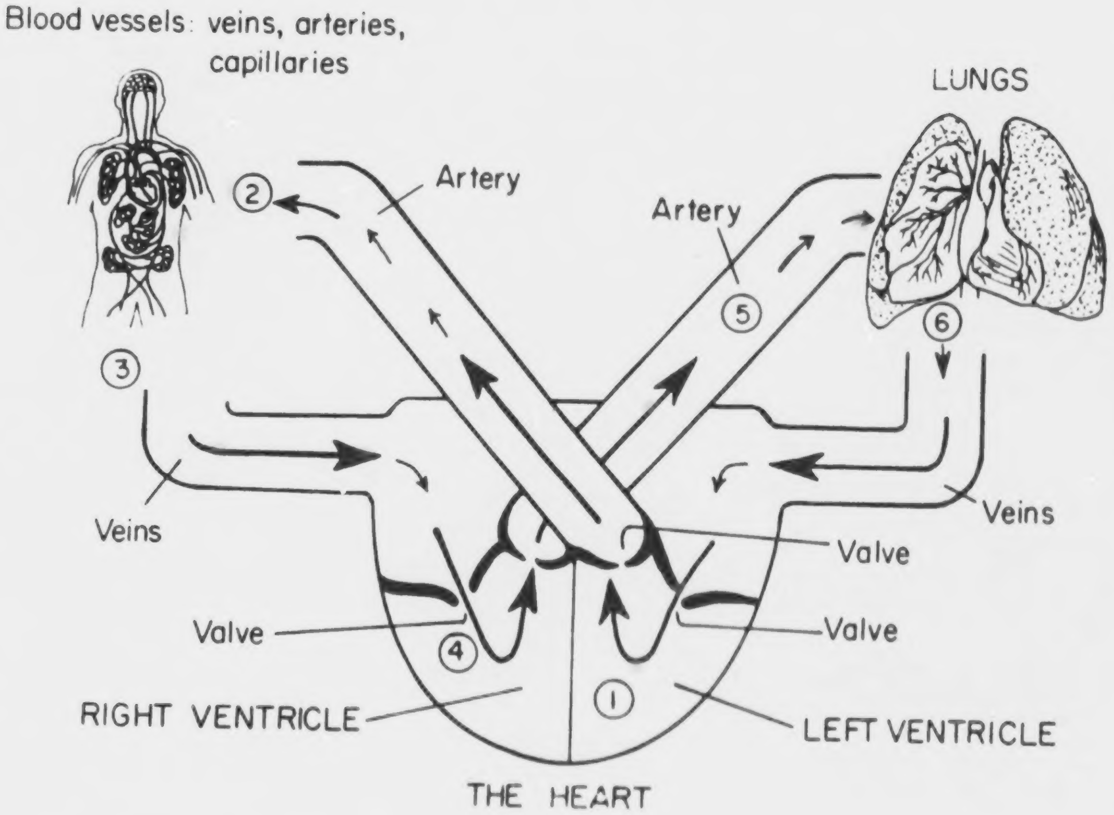
7. Continue the process until each student has listened to a heartbeat.

8. Ask students to describe what is heard.

THE CIRCULATORY SYSTEM
Handout


Blood vessels veins, arteries, capillaries
LUNGS
Artery
Artery
Veins
Veins
Valve
Valve
Valve
Valve
RIGHT VENTRICLE
LEFT VENTRICLE
THE HEART

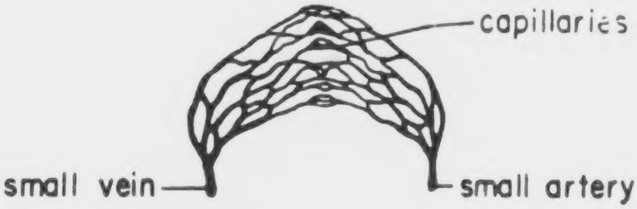
THE CIRCULATORY SYSTEM
Key


Blood vessels: veins, arteries, capillaries
LUNGS
Artery
Artery
②
③
⑤
⑥
Veins
Veins
Valve
Valve
Valve
④
①
RIGHT VENTRICLE
LEFT VENTRICLE
THE HEART

THE CIRCULATORY SYSTEM
Key

1. The pump on the left side of the heart pumps blood containing fresh oxygen and nutrients to all tissues of the body. The blood passes through tubes (blood vessels) called arteries.

2. The arteries branch out and get smaller and smaller. Finally, they form blood vessels called capillaries. The blood passes through the capillaries into very small veins.



3. As the blood travels through the tissues of the body and deposits fresh oxygen and nutrients, it collects carbon dioxide and waste materials that the body cannot use.

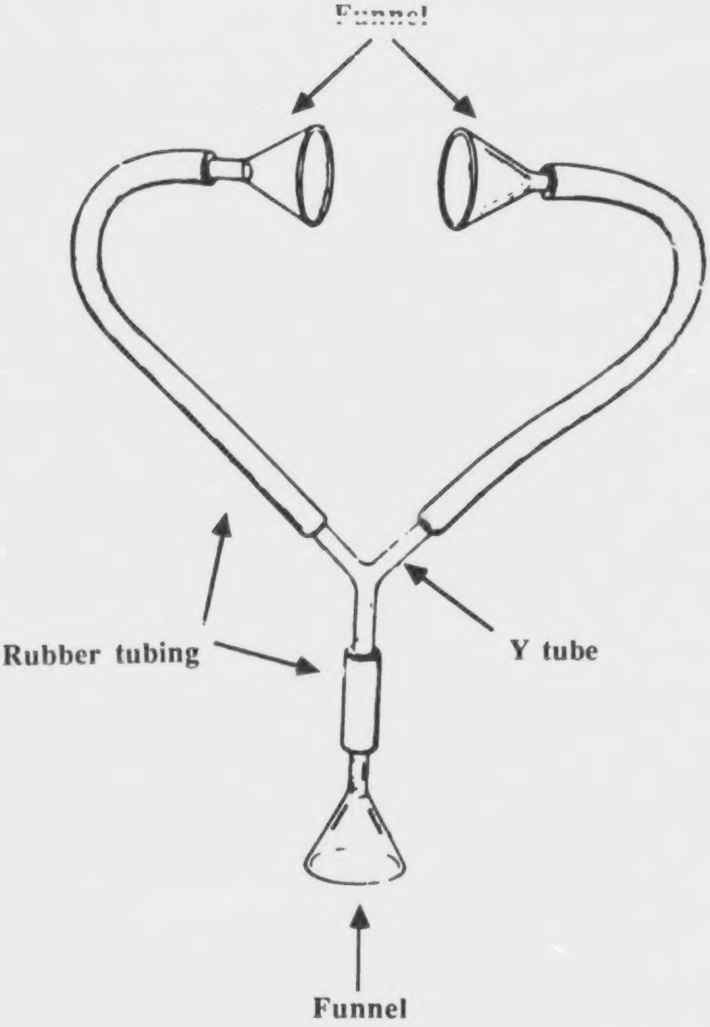
4. The veins gradually get larger and larger. As the blood is pumped toward the heart, the veins deposit wastes in the liver and other organs. The veins carry the blood containing the carbon dioxide to the right side of the heart.

5. The pump on the right side of the heart (the right ventricle) sends the blood to the lungs through arteries.

6. The lungs remove the carbon dioxide and replace it with fresh oxygen. The blood containing the fresh oxygen is pumped into the left side of the heart (the left ventricle). (Go back to #1.)

HOW TO MAKE A STETHOSCOPE
Handout

Cut a piece of rubber tubing to a length of 8 centimeters. Place one end of the tubing over the tip end of a funnel. Insert a T-tube into the other end of the short tubing. Attach longer pieces of tubing to each arm of the T-tube.


Funnel
Rubber tubing
Y tube
Funnel

GRADE 5
LIFE SCIENCE

UNIT: Growth and Maintenance
TOPIC: Circulatory System
OUTCOME: 27. Discuss components of blood and the function of each.

Background

The human body contains approximately six quarts of blood. Blood can be divided into a liquid part called plasma and solid materials called red cells, white cells, and platelets. The plasma or liquid part of the blood is mostly water (90 percent). It carries vitamins, minerals, hormones, and protein through the body to the cells. The blood also removes waste material. The solid part of blood is composed of three materials. Red blood cells are disk-shaped and contain hemoglobin which enables the cells to carry oxygen. Hemoglobin gives these cells their red color. Red blood cells carry carbon dioxide to the lungs. White blood cells are less numerous than red blood cells. They are larger, colorless, and have no exact shape. They move about in the body protecting it from disease. Platelets are smaller than red blood cells, irregularly shaped and colorless. They help in clotting. The clot acts as a plug when a blood vessel is damaged. They combine with fibrinogen in the plasma and calcium salts to produce fibers that slow the flow of blood. In each cubic millimeter of blood, there are approximately five million red blood cells, 8,000 white blood cells, and 250,000 platelets.

Materials

Transparency Master: BLOOD CELLS

For each group:
- Microscope
- Prepared slide of blood sample

For each student:
- Handout: COMPONENTS OF BLOOD

Procedures

1. Display the transparency BLOOD CELLS and discuss with the students the four parts of the blood: plasma, red blood cells, white blood cells, and platelets.

OUTCOME 27 (Continued)
Procedures (Continued)

2. Explain that plasma is the liquid part of blood and that the red cells, white cells, and platelets represent the solid parts of blood.

3. Review with students the important functions of each component of the blood.

4. Tell students that blood is a tissue but differs from other tissues in the body because it is a liquid.

5. Divide the class into pairs, and distribute the handout COMPONENTS OF BLOOD and suggested materials. (Groups may be larger if materials are limited.)

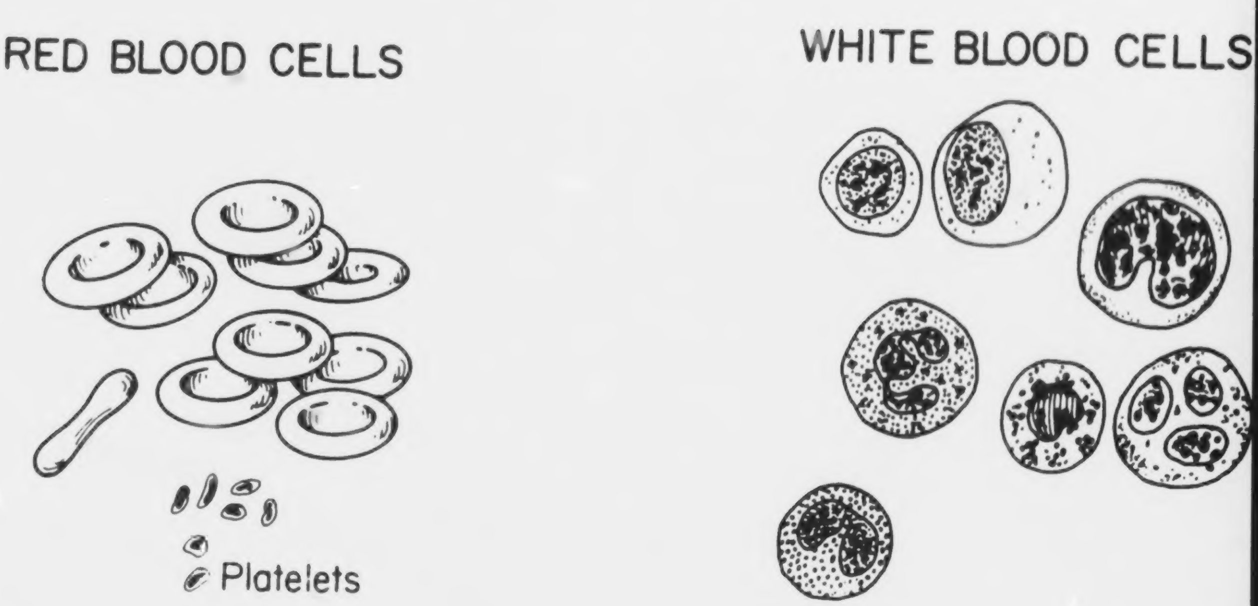
6. Tell the students to observe the slide of the blood smear under the microscope and complete the handout COMPONENTS OF BLOOD.

7. Discuss any information the students need to complete the handout.

8. Select students to read and display their handouts COMPONENTS OF BLOOD.

BLOOD CELLS
Transparency

BLOOD


RED BLOOD CELLS
WHITE BLOOD CELLS
Platelets

COMPONENTS OF BLOOD
Handout

	Plasma	Red Blood Cells	White Blood Cells	Platelets
Function				
Shape				
Color				
Draw a picture of the solid components of blood.				
No. per cubic mm				

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Weather Factors
OUTCOME: 28. Describe ways heat energy, water movement, and air movement affect weather.

Background

The sun provides light, heat, and power. On warm summer days the sun shines straight down for an average of fifteen hours each day. On winter days the slanted rays from the sun warm the earth for an average of nine hours a day.

Air helps to make weather. Air is all around the earth, and the earth could be described as wrapped in a blanket of air. Air is warmed by the sun. The warm air rises, and the cool air comes in underneath. The movement of air is wind. Wind is an important part of the weather.

Heat supplied by the sun, wind, and water affects the weather. Water from oceans, rivers, lakes, and other sources is warmed by the sun. Evaporation takes place. The water that evaporates into the air forms water vapor. When the air filled with water vapor cools, the water vapor condenses and forms clouds filled with tiny water droplets. As these water droplets become too heavy to stay in the air, they fall as rain.

If water droplets fall through very cold air, they freeze and fall as sleet. Hail is formed when frozen water droplets are swept back upward by air currents to freeze again. The ice falls and is swept back to form layers of ice. Finally, the ice becomes heavy enough to fall as hail. Snow forms when water vapor freezes before it can change into rain.

An air mass is a large column of air that collects over a region. An air mass is affected by the region it covers. Air masses that form over land are dry air masses. Air masses that form over water are moist. Air masses that form over cold regions are cold. Air masses that form over warm regions are warm.

Air masses that form over cold land areas are cold and dry and are called continental polar air masses.

Air masses that form over oceans are called maritime air masses. If these air masses are moist and cold, they are called maritime polar air masses.

Warm air masses are formed near the equator and are called tropical air masses. When they form over water near the equator, they are called maritime tropical air masses.

OUTCOME 28 (Continued)
Background (Continued)

Continental tropical air masses are warm and dry and are formed over land near the equator. Air masses move away from the areas where they form. As the air masses move, they bring various kinds of weather with them.

A map of the United States is used to show how the various air masses form and move across the United States.

A chart is used to help the students list the important types of air masses that affect weather across the United States.

Materials

- Scissors
- Glue
- Globe
- Reference books with maps of the United States
- Transparency Master: CHARACTERISTICS OF AIR MASSES

For each student:
- Handout: AIR MASS CHART
- Handout: THE UNITED STATES
- Construction paper, red and blue

Procedures

Part A

1. Discuss the background information with the students.

2. Use a globe to point out to the students where continental, maritime, tropical, and polar air masses form.

3. Display the transparency CHARACTERISTICS OF AIR MASSES to illustrate a flat visual of the different locations for each air mass. Explain to the students the characteristics of weather associated with each air mass.

4. Distribute and explain the handout AIR MASS CHART to the students. Direct the students to fill in the appropriate information under each column.

5. Check each student's chart to be sure he or she understands maritime polar, continental polar, maritime tropical, and continental tropical air masses.

OUTCOME 28 (Continued)
Procedures (Continued)

Part B

1. Distribute to each student the handout THE UNITED STATES.

2. Write the following cities on the board and ask the students to locate and label these cities on their maps.

    a. Los Angeles, California
    b. Chicago, Illinois
    c. New York City, New York
    d. Miami, Florida
    e. Denver, Colorado
    f. Houston, Texas
    g. Bismark, North Dakota
    h. Augusta, Maine
    i. Seattle, Washington

3. Tell the students to cut small red and blue arrows from the construction paper. Tell the students to write continental polar and maritime polar on the blue arrows. Tell the students to mark maritime tropical and continental tropical on the red arrows.

4. Tell the students to glue the maritime polar arrows near the cities that would be affected by this air mass. Tell the students to glue the continental polar arrows, the maritime tropical arrows, and the continental tropical arrows near the cities that would be affected by each of these air masses.

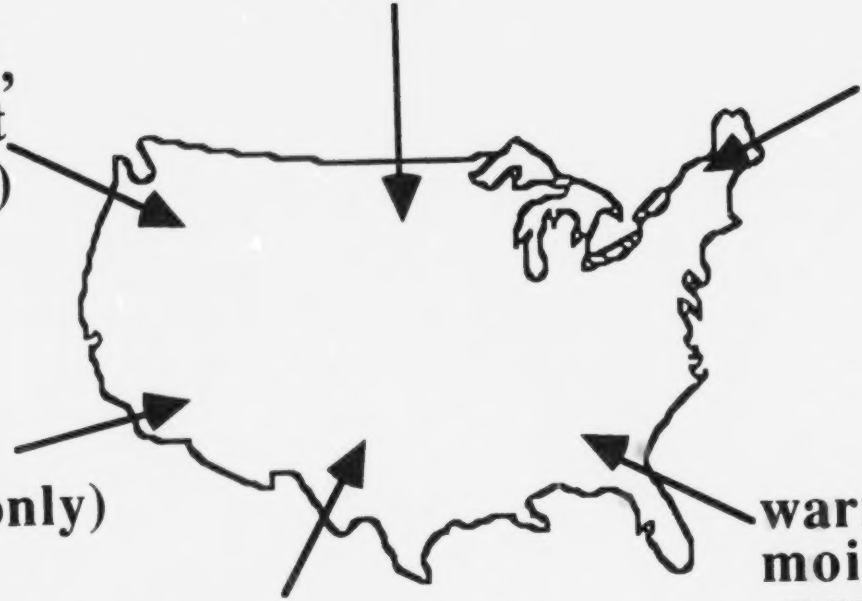
5. When the activity is completed, have the students compare their maps and explain why they thought a certain air mass would affect each city on their maps.

6. Have students compare their completed maps with the transparency CHARACTERISTICS OF AIR MASSES.

AIR MASS CHART
Handout

Type of Air Mass	Where does it form?	What kind of weather does it bring?
Maritime Tropical		
Continental Tropical		
Maritime Polar		
Continental Polar		

CHARACTERISTICS OF AIR MASSES
Transparency



cold,
dry
(CP)

cold,
moist
(MP)

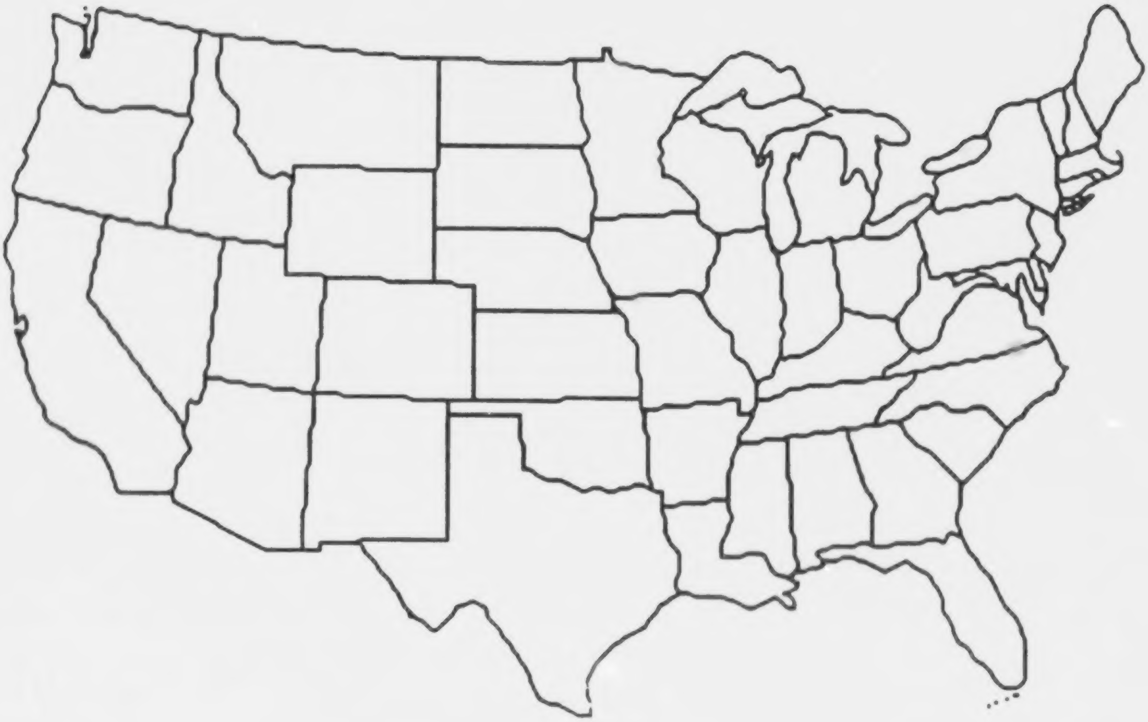
cool,
moist
(MP)

warm
moist
(winter only)
(MT)

dry,
hot
(CT)

warm
moist
(MT)

THE UNITED STATES
Handout



GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Weather Factors
OUTCOME: 29. Define the weather terms lows, highs, fronts, and precipitation.

Background

Students need to learn weather terms in order to understand and communicate effectively. The attached list of terms may be expanded as needed.

Materials

- List of weather terms

For each student:
- Handout: WEATHER TERMS BINGO
- Tokens (9)

Procedures

1. Write the weather terms on the chalkboard. Instruct students to define the terms, using their textbooks. Allow sufficient time for this task to be accomplished.

2. Distribute the handout WEATHER TERMS BINGO. Direct students to write one of the terms in each of the squares on the grid (in any place they wish.) Also tell students to remove the definitions from sight. Announce that they will play WEATHER TERMS BINGO.

3. Read a definition to the class. Tell students to use their tokens to cover the words they think the definitions match. Continue until someone wins (horizontal, vertical, diagonal, or blackout.) Check to see if the winner selected the correct terms. Continue playing the game until the students know the terms well.

4. Have students write and illustrate a weather story using the terms.

WEATHER TERMS BINGO

WEATHER TERMS

1. Lows:	regions of low barometric pressure
2. Highs:	regions of high barometric pressure
3. Front:	the place where two air masses meet
4. Precipitation:	a deposit of hail, mist, rain, sleet, or snow on the earth; also, the quantity of water deposited
5. Sea breeze:	the movement of air from water to land
6. Land breeze:	the movement of air from land to water
7. Air mass:	a large body of air that has about the same temperature and moisture throughout
8. Cold front:	the place where a moving cold air mass meets a warmer air mass
9. Warm front:	the place where a moving warm air mass meets a colder air mass

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Weather Factors
OUTCOME: 30. Explain how changes in ocean currents affect weather.

Background

Even though the ocean appears to be quiet, streams of water are flowing under the surface and at the surface of the ocean. These streams are called currents. Warm winds can cause surface currents to flow. When one current meets another, a new current may be formed. Warm ocean currents sometimes cause places near the ocean to be warmer than expected. The warmer air causes these places to have a milder climate.

This activity will take two class periods to complete.

Materials

For each group:
- Container of water
- Cup, paper
- Glass bowl, clear
- Food coloring, any color
- Tray, plastic

For each student:
- Handout: MAP OF OCEAN CURRENTS

Procedures

Day One

1. Distribute the handout MAP OF OCEAN CURRENTS. Explain the warm and cold currents. (See background information.)

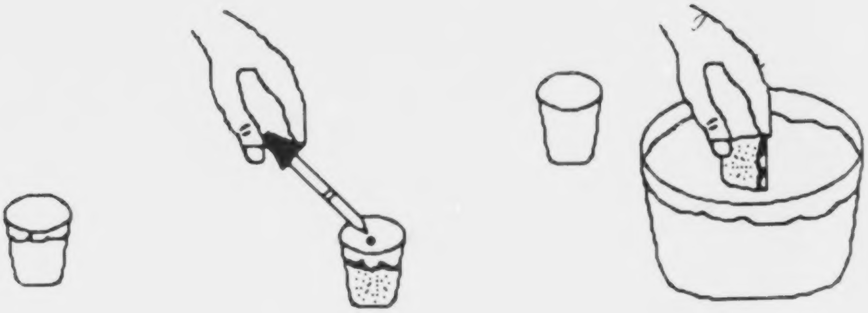
2. Assign students to groups of no more than five students.

3. Distribute cups, water, food coloring, and a clear bowl to each group.

4. Tell the students that they will be able to see how some ocean currents are formed.

OUTCOME 30 (Continued)
Procedures (Continued)

5. Instruct the students to fill the paper cup half full with water and mix with a few drops of food coloring. Ask one student to take the paper cups from all of the groups to the lunchroom freezer. (Provide a tray for carrying purposes.)

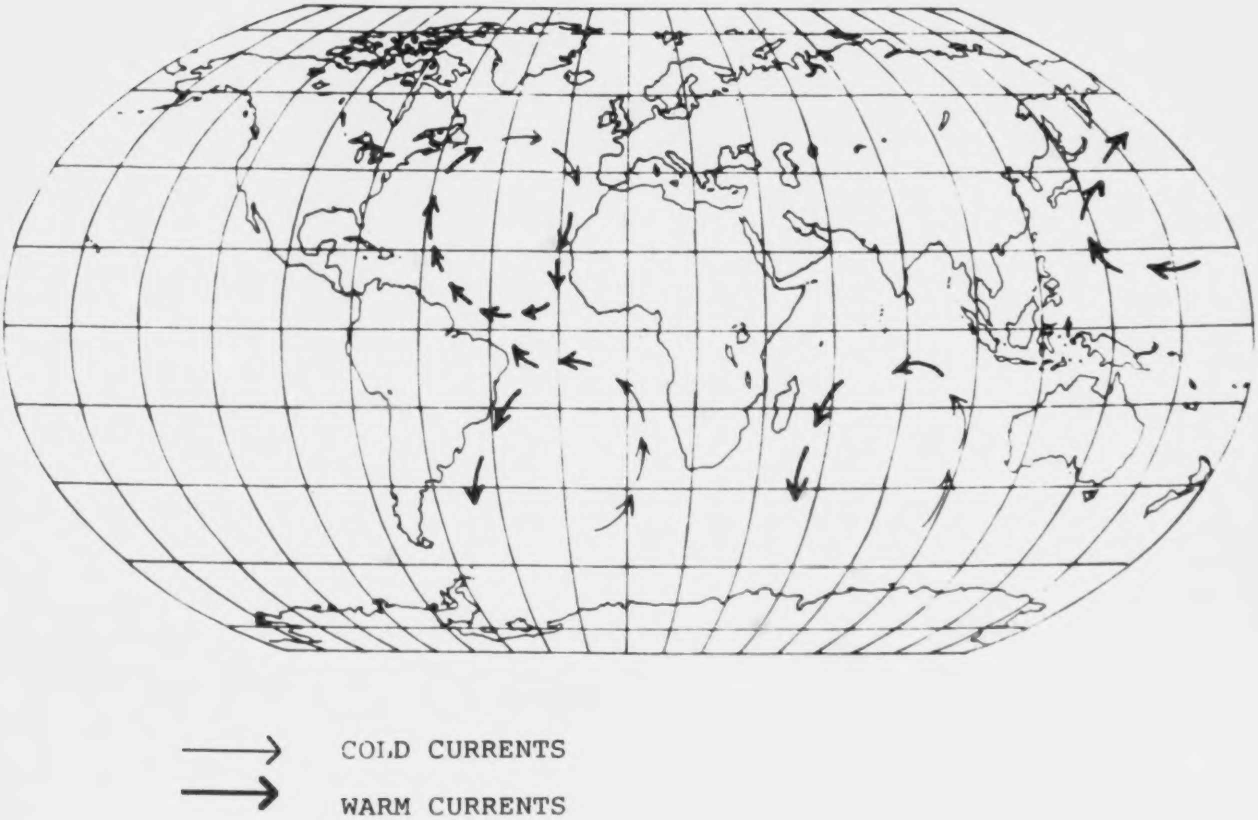


Day Two

1. Send a student to retrieve the frozen ice cups. Direct the students to remove the colored ice from the paper cups, and put it into the bowl of water. Instruct the students to observe what happens next.

2. Ask the students to tell what happens to the water around the ice. Why? (Warm water is lighter than cold water, so warm water rises to the surface. Cold water moves in under the warm water.) This experiment illustrates a convection current. The ice represents the polar zones which usually have cold and dry weather. The heat source represents the tropical zones which usually have dry and hot or warm and moist weather.

MAP OF OCEAN CURRENTS
Handout


COLD CURRENTS
WARM CURRENTS

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Effects of Weather
OUTCOME: 31. Explain the effects that weather has on plans for recreational activities or travel.

Background

Most people want to know about the weather; for example, inclement weather can halt plans for picnics, ball games, or the launch of a space shuttle. It can also delay planes, ships, and trains. Trips and vacations are often canceled because of weather conditions. Reviewing a chart of the daily, weekly, and monthly rainfall in an area could help one to plan a trip by identifying periods in which the weather conditions would be more favorable.

Materials

For each student:
- Handout: CENTIMETERS OF RAINFALL IN A YEAR
- Handout: WEATHER ACTIVITY

Procedures

1. Distribute the handout CENTIMETERS OF RAINFALL IN A YEAR to students. Explain that this is the amount of rain that fell in each of the four cities listed during one year's time. Use the following to ensure that the students are able to read the chart.
   a. How much rain fell in Peach City in February? (29 cm)
   b. How much rain fell in Appleton in November? (11 cm)
   c. Which city had the least amount of rain in December? (Orangeburg, 6 cm)
2. Ask the students if people prefer to take vacations during months with little rain or much rain. Discuss the reasons why people prefer vacations in months with little rain. Ask students to make a list of activities that can occur on rainy days. Then, have them list activities that can occur on sunny days. Write the lists on the chalkboard. Which list is longer? Discuss why the list for sunny days is probably longer.
3. Direct students to use this information to complete the handout WEATHER ACTIVITY.

CENTIMETERS OF RAINFALL IN A YEAR
Handout

	Appleton	Pearville	Peach City	Orangeburg	Total
Jan.	16 cm	18 cm	28 cm	8 cm	70 cm
Feb.	15	15	29	9	68
Mar.	16	16	27	8	67
Apr.	10	10	18	14	52
May	8	8	18	16	50
June	6	10	8	20	44
July	4	12	8	24	48
Aug.	2	14	9	18	43
Sept.	4	12	10	12	38
Oct.	9	15	11	8	43
Nov.	11	15	20	6	52
Dec.	12	14	26	6	58
Total	113	159	212	149	633

WEATHER ACTIVITY
Handout

Directions: Use the handout CENTIMETERS OF RAINFALL IN A YEAR to complete this handout. Remember, most people want to take their vacations during months of little rainfall.

1. During which month would it be best to visit Pearville?

2. Which of the four cities had the least amount of rain during the year?

3. The Smiths will be taking a vacation trip in November. From the chart, select which city would have the best weather (the least amount of rain).

4. How much more rain fell in Peach City in December than in August?

5. Which of the months had the least amount of rain?

Below, draw a picture of a rainy-day activity or a sunny-day activity.

WEATHER ACTIVITY
Key

Directions: Use the handout CENTIMETERS OF RAINFALL IN A YEAR to complete this worksheet. Remember, most people want to take their vacations during months of little rainfall.

1. During which month would it be best to visit Pearville? (May)

2. Which of the four cities had the least amount of rain during the year? (Appleton, 113 cm)

3. The Smiths will be taking a vacation trip in November. From the chart, select which city would have the best weather (the least amount of rain). (Orangeburg)

4. How much more rain fell in Peach City in December than in August? (17 cm)

5. Which of the months had the least amount of rain? (September)

Below, draw a picture of a rainy-day activity or a sunny-day activity.

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Effects of Weather
OUTCOME: 32. Explain how weather determines the cost or availability of food.

OUTCOME: 33. Explain how prewarning forecasts saves lives and property when tornadoes, hurricanes, floods, or freezing occur.

Background

A reliable and affordable food supply is essential to a nation's welfare. In an ideal situation, the demand for food is nearly equal to the supply. Some surpluses are desirable as security against future shortages. When the demand for food is greater than the supply, prices rise. Conversely, when the supply is greater than the demand, prices drop.

Farmers and ranchers are at the mercy of the weather. Drought, with its searing heat, causes pastures and fields to wither and die. Seeds will not sprout without sufficient moisture. During a recent drought, cattlemen were forced to sell their livestock to slaughter houses before they starved to death. The initial effect was a decrease in the price of meat, but the long term effect is an increase in the price of meat due to the high feed prices and the cost of restocking herds.

Shifts in weather patterns can affect the price and availability of food. Late arrival of warm weather and the early arrival of cool weather shortens the growing season. In areas where the growing season is already short, any further shortening of the growing season can be disastrous to the crops. Floods or excessive rain can cause seeds to rot in the ground and can drown standing plants. Hail storms can beat crops so severely that they cannot be salvaged. Freezing weather after fruit trees have budded can destroy or reduce the fruit crop.

When there are crop failures in one area, food supplies must be shipped. Transportation costs are added to the price of food at the retail level, resulting in higher food prices.

Meteorologists and the Weather Bureau obtain information about atmospheric conditions to help people prepare for conditions that influence their lives.

OUTCOMES 32 and 33 (Continued)

Background (Continued)

Preceding a cold front, severe weather conditions such as tornadoes, hurricanes, and blizzards may occur. Weather stations across the nation are equipped with radar and other sophisticated equipment that help meteorologists predict these storms. With early warning, lives and property can be saved. The activity will take more than one class period.

This activity addresses the day-to-day effects that the weather has on the cost or availability of certain foods and how pre-warning forecasts saves lives and property.

Materials

- Samples of weather maps showing cold fronts
- School and other safety procedures for severe weather conditions
- Resources for research activity

For each student:
- Handout: WEATHER MAP
- Pencil or pen
- Crayons or markers

Procedures

1. Explain to the students how weather affects the cost and availability of food.

2. Display the newspaper weather maps. Discuss how cold fronts are drawn on the maps.

3. Discuss how cold fronts affect weather conditions.

4. Assign the students to work in three groups. Assign each group a specific severe weather condition to research (a tornado, a hurricane, or a blizzard). Remind the students to include how weather determines cost or availability of certain foods during different seasons or after a major weather disaster.

5. Instruct each group to collect a list of safety precautions appropriate for a set of assigned severe weather conditions. (Remind the group assigned the hurricane to consider the effects on coastal areas in Alabama.)

6. Distribute the handout WEATHER MAP to the students. Instruct the students to draw a cold front on their maps.

OUTCOMES 32 and 33 (Continued)

Procedures (Continued)

7. Ask each group to develop a handbook giving a brief description of the severe weather, the possible effects, and a list of safety precautions to be followed. Suggest that the handbook have illustrations.

8. Provide class time for research and group writing. Give assistance where needed.

9. Instruct a member from each group to share the completed handbook with the class. Discuss the results.

10. Display the completed weather maps and the handbooks.

Extensions

1. Research how weather has affected the cost and availability of food over the past five years. Write the figures for the price changes of corn and wheat on the chalkboard.

2. Invite a produce manager from a local grocery store to speak to the science class. Ask him or her to explain how weather affects the price and availability of produce at his or her store. Encourage the students to ask questions.

WEATHER MAP
Handout

GRADE 5
EARTH SCIENCE

UNIT: Earth Science
TOPIC: Effects of Weather
OUTCOME: 34. Explain results in the loss of lives and damage to property caused by hurricanes, tornadoes, or other weather phenomena.

Background

Severe weather phenomena such as hurricanes, tornadoes, and thunderstorms occur frequently. The students will use newspapers and magazines for collecting pictures and articles and then interpret the information by completing an activity sheet for each occurrence. Tell students to keep the articles and activity sheets in a special notebook. They may draw pictures to illustrate the weather if no picture is available.

Materials

- Newspapers
- Magazines
- Paper and cover material for notebook
- Pencils and drawing materials
- Handout: WEATHER ACTIVITY

Procedures

1. Discuss severe weather conditions with the students. Ask students to identify the different phenomena and safety precautions that should be observed.

2. Announce to students that they are to prepare notebooks about the weather. Tell students that they may share their notebooks with the class at the end of the activity.

3. Ask students to bring newspapers and magazines from home. Instruct students to look through the newspapers and magazines for articles or pictures depicting weather events. Ask them to cut out the articles and pictures, and complete an activity sheet for each weather event located. If there is no picture with an article, ask the student to draw one.

4. Distribute the handout WEATHER ACTIVITY. Discuss the questions.

5. Allow sufficient time during class for students to complete at least one weather event.

OUTCOME 34 (Continued)
Procedures (Continued)

6. Assign a completion date for the weather notebooks.
7. Schedule time during class for sharing the weather notebooks.
8. Display the completed notebooks in the classroom or in the media center.

Extension

Display a map of the United States and use colored tacks to pinpoint areas that experience severe weather during the school year or during the unit of study on the weather.

WEATHER ACTIVITY
Handout

1. Date of event:

2. Location:

3. Type of event (hurricane, tornado, and others):

4. Explanation of event:

5. Property damage:

6. Deaths or injuries:

7. Safety precautions that should be observed in similar situations:

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Effects of Weather
OUTCOME: 35. Explain how pollutants at low levels in the air cause heat inversions to occur.

Background

Inversion of temperature is an atmospheric condition in which temperature increases with altitude within a layer of the atmosphere (seven to ten miles above the earth). Usually temperature decreases with altitude, but the opposite condition exists in a temperature inversion. Measureable characteristics of an inversion are: thickness of the inversion layer, rate of temperature increase of the layer with increased altitude, and total temperature increase from the bottom to the top of the inversion layer. Temperature inversions greatly affect weather conditions by determining cloud forms, precipitation, or visibility. It acts as a lid to vertical movement of the air from the dense cold air below. For this reason, low-level inversions next to the earth cause an increase in air pollution by holding smoke and dust close to the earth. They reduce visibility by holding clouds or fog.

Sometimes low-level inversions inhibit precipitation by preventing clouds from being heated and rising high enough to produce showers. Dense fog that is formed from temperature inversions is one of the greatest hazards to aviation and to all forms of surface transportation. Dense fogs which last for days are associated with low temperatures and high levels of pollution which may cause widespread illness. They may cause death among sufferers of bronchitis, emphysema, and other respiratory complaints and allergies. Many people suffer from depression when the normally blue sky is blocked by a brownish haze. Scientists blame air pollution for the rise in lung cancer among certain animals.

Materials

- Jar, quart
- Water
- Cooking oil (1/2 c.)
- Food coloring, blue
- Reference books

For each student:
- Handout: FORMATION OF INVERSION OF FOG

OUTCOME 35 (Continued)

Procedures

1. Distribute the handout FORMATION OF INVERSION OF FOG to students. Refer to the information written under the illustration on the handout which explains the reasons for the formation of an inversion fog.

2. Explain to the students that inversion means a reversed order. Tell them that in a temperature inversion, the warm air that is normally close to the earth exchanges positions with the cold air which is normally on top of the warm air. Explain that air normally becomes cooler as it rises and warmer as it becomes closer to the ground. Tell students that in a temperature inversion, the opposite effect occurs with the cool air being trapped near the ground.

3. Direct two students to demonstrate a model of inversion for the class to view. Have students fill the quart jar half full of water. Tell students to place two drops of blue food coloring into the water and stir to mix. Next, add the cooking oil to the water. (Two layers will form in the jar.)

4. Have students write their observations in their notebooks. Tell them to explain how the model relates to a temperature inversion. (The blue water represents the cool dense air and the oil represents the warm lighter air.)

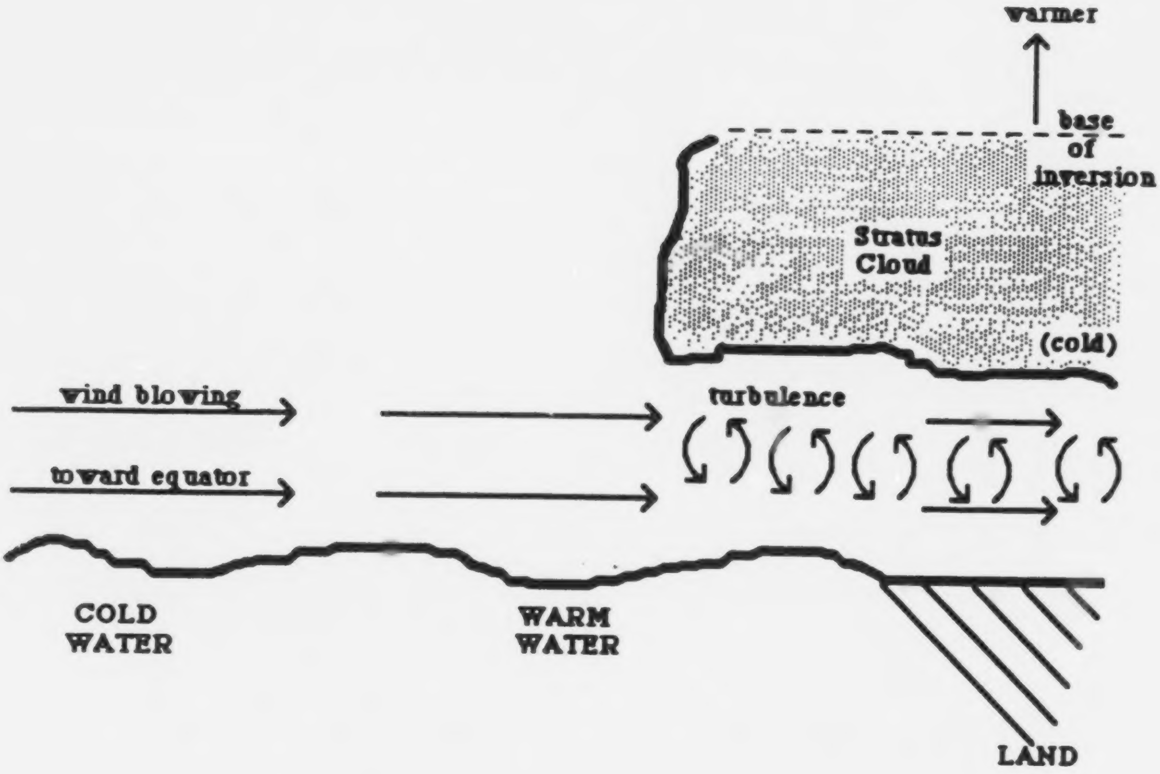
5. Assign students research topics on air pollution as related to temperature inversion. Topics may include the following:

    1. Health Hazards For Humans and Animals
    2. Plant Destruction
    3. Building Deterioration Caused by Corrosion

Extension

Ask for volunteers to make posters from the illustration sheet showing the formation of inversion fog. Display posters.

FORMATION OF INVERSION OF FOG
Handout


warmer
base of inversion
Stratus Cloud
(cold)
wind blowing
toward equator
turbulence
COLD WATER
WARM WATER
LAND

This illustration shows an example of an inversion formed as a result of a downward extension of a layer of stratus cloud, situated under the base of a low-level temperature inversion. As air passes over the cold water and becomes chilled, its relative humidity rises and it becomes trapped under the temperature inversion. When night air cools, it can cause a stratus layer to form and extend to the ground to form an inversion fog.

Source: Britannica Encyclopedia

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Controlling Weather
OUTCOME: 36. Explain how rainmaking chemicals are used in an effort to control weather.

Background

Much experimentation has been completed over the years to control the weather. Rainmaking, in particular, has received a great deal of attention. In 1946, Vincent J. Schaefer (working for the General Electric Company) noticed that tiny ice crystals glistened in the cloud caused by his breath while he was crumbling some dry ice into the deep-freeze compartment of his refrigerator. This gave him the idea that there was a connection between ice crystals and rain clouds. His first attempt at experimentation was to sow dry ice into a cloud from an aircraft. The experiment resulted in holes being created in a layer of dense clouds which indicated that the cloud droplets had disappeared at the places treated with dry ice. This led to other experiments using silver iodide since its crystal structure resembles that of ice. The best reason for using silver iodide was that a solution could be burned on the ground, thereby introducing the ingredient into the atmosphere in the form of microscopic smoke particles. Eventually the American Congress appointed a commission of scientists to investigate cloud-seeding processes. The problem is still unresolved. One fact seems to be accepted: clouds are most easily controlled when they already contain supercooled droplets which can be frozen by the seeding of dry ice or silver iodide.

Materials

- Research materials

Procedures

1. Ask the students if there are any parts of the world that do not receive enough rain. (Someone will suggest deserts.) Ask if they know of any method to help create rain. If no one mentions rainmaking, then introduce the term to the class.

2. Tell the students some of the background of early rainmaking efforts. Ask students if they think that rainmaking is a workable, dependable method to eliminate droughts. Discuss answers.

OUTCOME 36 (Continued)
Procedures (Continued)

3. Ask students if they think that rainmaking would always cause the exact amount of rain wanted. Discuss answers.
4. Ask students to predict the consequences of using rainmaking chemicals over the desert regions of the world. Discuss answers.
5. Tell the students that they are going to do some research on rainmaking efforts. Ask them to research desert areas, amount of rainfall per year, and rainmaking efforts in each area. Schedule a specific time period in the library for research. (Arrange with the librarian to have an adequate number of information sources available when needed.)
6. Allow students time to share information with their classmates.
7. Ask students to predict the helpful and possible harmful effects of altering weather conditions.

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Controlling Weather
OUTCOME: 37. Explain how arid areas of the world are made habitable.

Background

Desert regions compose about 20 percent of the earth's land area. These arid regions are inhabited by more than 80 million people, or about eight persons per square mile. Large areas are uninhabited. The only densely populated areas are the irrigated lands of places such as the lower Nile River area of Africa.

Desert life is changing as irrigation systems increase. In some countries water for irrigation comes from very deep wells. In others, rivers atop snow-capped mountains furnish water to the land below. In addition to providing water for irrigation, giant river control systems have been developed to supply water for electrical power, to control floods, and to provide a place for recreation. A dependable water supply enables arid regions to support a larger population of people and animals.

In the United States, irrigated lands are used mostly for commercial crops such as citrus fruits, winter vegetables, dates, and cotton.

Irrigation methods depend on local conditions such as land forms, crops to be grown, location of the water supply, and drainage of the land. Modern irrigation methods fall into one of five methods: (1) flooding, (2) furrow irrigation, (3) subirrigation, (4) sprinkling, and (5) drip irrigation. Of the five methods, sprinkling is the most convenient way to irrigate; however, drip irrigation is the most effective. Sprinklers can be placed where they are needed, and the flow rate is easier to regulate.

Materials

- Gloves, rubber
- Needle, large
- Baking pan, aluminum, approximately 7" x 10" x 1"
- Soil
- Water
- Bag ties, plastic (4 or 5)
- Newspapers
- Reference books

OUTCOME 37 (Continued)

Procedures

1. Explain to the students how large areas of arid land are made habitable through the use of irrigation. Describe the most common systems.

2. Divide the class into four groups. Explain that some students will work on a research project while others will make a miniature irrigation system.

3. Assign research topics to three of the groups:
    a. History of irrigation

    b. Irrigation methods
        1. Flooding
        2. Furrow irrigation
        3. Subirrigation
        4. Sprinkling
        5. Drip irrigation

4. Direct the research groups to gather their information from newspapers, articles, or other reference materials on irrigation.

5. Direct the fourth group of students to construct a miniature irrigation system. Spread newspapers on the surface to be used. Have them ask another student to fill the baking pan with soil. Puncture the ends of the glove fingers. Direct one student to hold the glove open while another student fills the glove with water, leaving room at the top to tie with a bag tie. Tie the end of the glove above the water line. While one student holds the glove securely, have another squeeze the glove area above the fingers to force water through the holes in the ends of the fingers.

6. Direct the group constructing the irrigation system to prepare a report in relating the glove demonstration to the sprinkling action of the irrigation system.

7. Direct each group to choose a person to make an oral report on the assigned topic.

Extension

Ask students to bring lawn sprinklers from home to share with the class. Compare the various types. How are they alike? How do they differ? How do they relate to other irrigation methods?

GRADE 5
EARTH SCIENCE

UNIT: Weather
TOPIC: Seasonal Changes
OUTCOME: 38. Explain how plants and animals have adapted to seasonal changes.

Background

Migration and hibernation are two methods that animals use to adapt to seasonal changes. Many amphibians survive the cold winter months by burying themselves in the mud at the bottom of lakes and ponds (hibernation). As their bodies become cold, their activities decrease. Their hearts beat more slowly. They use less energy and need less oxygen. In the spring, their bodies become warmer and activities increase again. Some reptiles and mammals also hibernate. Birds, on the other hand, move to warmer climates during the cold winter months (migration). Scientists have questioned the idea that bears are true hibernators. Bears are not classified as hibernators because their body temperatures fall only slightly during the winter sleep. The bear's large body does not lose as much heat as do small bodies of other hibernators; therefore, its body temperature stays high during hibernation. This activity will address only how animals have adapted to seasonal changes.

Materials

For each student:
- Cardboard, 5" x 7" (2)
- Adhesive-backed paper, approximately 15" x 9"
- Paper, 4" x 6" (10)
- Stapler
- Research and reference books
- Markers or crayons

Procedures

1. Explain to the students how animals have adapted to seasonal changes.

2. Discuss what adaptation means, and allow students to suggest animals to use in the making of a booklet about how animals adapt to seasonal changes.

3. Explain to the students that they are going to make a booklet. The booklet will be used to list and illustrate animals that adapt to seasonal changes such as bears, shrews, and rodents.

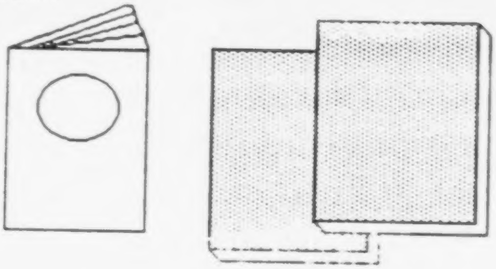
OUTCOME 38 (Continued)
Procedures (Continued)

4. Instruct a student or small group of students to make a Contents page for the book by listing alphabetically animals included in the book.

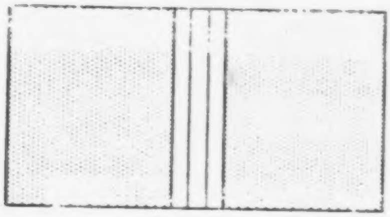
5. Instruct a student or a small group of students to think of a title and make a title page for the book which includes the title, date, and class. (Example: Quiet Spring by Mrs. Smith's Class, March 1989).

6. Compile the book pages by placing each report under the accompanying title page in the order listed on the Contents page. Place the Contents page on top of the reports and the Title page on top of the Contents page. Staple the entire stack together in three places at the left margin.

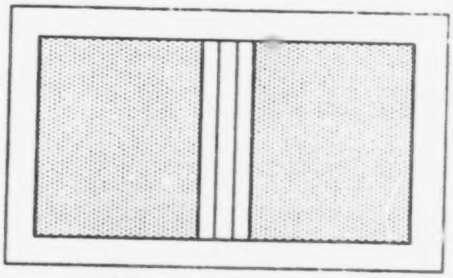
7. Cut two pieces of heavy cardboard slightly larger than the pages of the book.



8. With masking tape, tape the two pieces of cardboard together with a half-inch space between them.

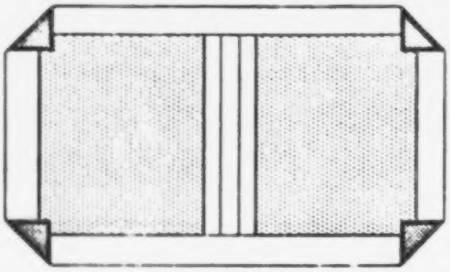


9. Cut the outside cover one and one-half inches larger than the cardboard, and stick it to the cardboard (use thinned white glue if cover material is not self-adhesive).

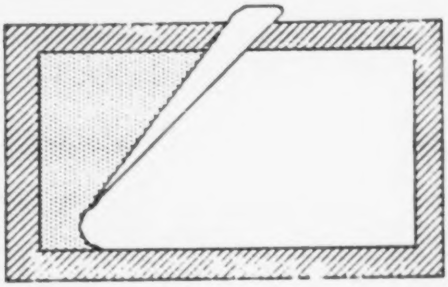


OUTCOME 38 (Continued)
Procedures (Continued)

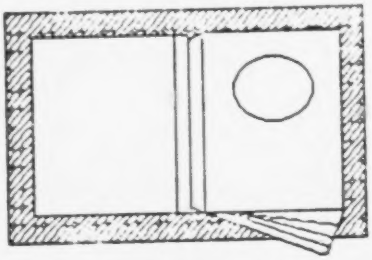
10. Fold corners over first, then the sides.



11. Measure and cut inside cover material and apply as shown.



12. Place stapled pages of the book in the center of the cover. Secure with two strips of inside cover material, one at the front of the book and the other at the back.



13. Display booklets in the class library when finished.

GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Importance to People
OUTCOME: 39. Compare the percentage of the earth's surface that is covered with water to the percentage that is dry land.

Background

The ocean covers approximately three-fourths of the earth's surface. Because there is so much more water on the earth than there is dry land, the ocean plays an important part in the lives of the earth's inhabitants. It affects the weather and is capable of supplying huge quantities of food for the world's people.

Illustrating the comparison of water to dry land on the surface of the earth will help students understand the relationship of land to water and will lead them to an appreciation of the importance of the ocean to people living on the earth.

This activity will require forty-five minutes to an hour. Measure 1/4 cup of modeling clay or plastic dough before beginning the activity.

Materials

- Globe

For each group:
- Pie plate, aluminum, 9 1/2 inch
- Container of water
- Spoon
- Modeling clay or plastic modeling dough (1/2 cup)
- Food coloring, blue (optional - 1 drop)

Procedures

1. Using the globe as a visual aid, discuss the fact that three-fourths of the earth's surface is covered with water. Have students try to imagine the comparison of water to land if all surface land could be combined in one location on the globe.

2. Divide the class into small groups.

3. Give each group a pie plate, a small amount of clay, and a container of water.

OUTCOME 39 (Continued)
Procedures (Continued)

4. Direct students to cover one-fourth of the pie plate with clay.

5. Have students pour water into the pie plate up to the level of the clay. Allow them to color the water with one drop of food coloring, if desired.

6. Direct the class to draw conclusions about the relationship of water to land on the earth. Ask students the following questions: What percentage of the pie plate is covered with clay? (25%) What does the clay represent? (Land) What percentage of the plate is covered with water? (75%) What does the water represent? (Oceans) List on the chalkboard some reasons why the ocean is important. (Some possible answers may include travel, recreation, a source of food, a factor affecting weather conditions, and a source of minerals.)

GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Importance to People
OUTCOME: 40. Discuss the importance of the ocean in our lives.

Background

The ocean is important for the existence of life on Earth in at least four major ways. Ocean waters are connecting links between continents, providing easy travel and communication among people of foreign lands. The oceans are a source of food: providing fish, shellfish, and sea mammals. The world's economy is greatly affected by the fishing industry, which provides jobs for fishermen, factory workers who process the food to be sold, and the ship-building industry. The oceans provide valuable products such as magnesium, which is used in making rockets, iodine, and other minerals.

Some other areas of importance to explore with the class are recreation, the ocean as a source of fresh water by means of a process known as desalination, and the effect that the ocean has on the weather on the land.

After a classroom discussion of various ways in which the ocean is important to living things, students will define the concept in their minds by brainstorming and illustrating one particular area of importance. This activity will require two consecutive forty-five minute class sessions. Students will work in small groups. A variety of textbooks, encyclopedias, and magazines will be helpful to aid students in illustrating their ideas.

Materials

For each group:
- Poster board
- Crayons or colored markers
- Various resource materials

For each student:
- Handout: WORDSEARCH: OCEANOGRAPHY

Procedures

Day One

1. Lead the class in a discussion of the various ways in which the ocean is important to living things.

OUTCOME 40 (Continued)
Procedures (Continued)

2. Divide the chalkboard into four or five sections. Direct students to title each section with one major area of importance such as travel and communication, source of food, world economy, products, or recreation.

3. Under each title, have students list reasons why the ocean is important.

4. Divide the class into groups of no more than four students.

5. Assign an area of importance to each group. (More than one group may work on the same area, if necessary.) Explain that each group is to draw illustrations concerning the ocean's importance. Ask group members to give an explanation of their posters to the rest of the class.

6. Distribute one poster board and a set of crayons to each group of students.

7. Direct students to assimilate ideas and begin sketching drawings. Explain that they will finish their work and present their posters to the class on the following day.

Day Two

1. Allow groups to complete work on posters and organize in groups to practice their presentations.

2. Have groups take turns presenting and explaining completed work to the rest of the class.

3. Conclude the activity by distributing handout WORD SEARCH: OCEANOGRAPHY for students to complete.

Extension

Have students design their own word search based on their areas of study and their posters.

WORD SEARCH: OCEANOGRAPHY
Handout

See if you can find at least 17 ways in which the ocean is important in our lives. Answers may be listed vertically or horizontally.

Z T R C V S C F H I K M J W X S

B V E C J K O K I O D I N E X W

P E C O N O M Y B F D G L L U E

Y T R M B V M D S A Z S A L T A

L K E N B V U U F I S H I N G T

T R A V E L N K M N O I T F D H

K U T F D S I C X D X P Z R M E

J U I N M B C Z X U R B W E A R

O F O O D I A C T S X U Z S G G

B L N I O P T O R T U I R H N G

S J N M Y M I N E R A L S W E A

L K J H U Y O K B Y F D W A S S

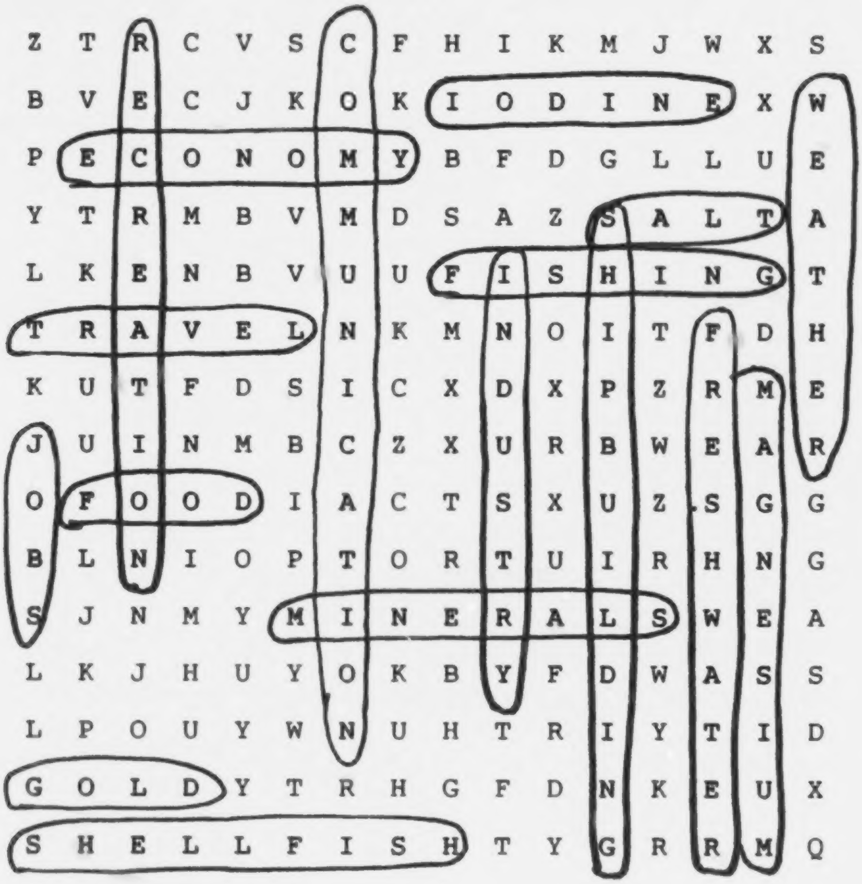
L P O U Y W N U H T R I Y T I D

G O L D Y T R H G F D N K E U X

S H E L L F I S H T Y G R R M Q

WORD SEARCH: OCEANOGRAPHY
Key

See if you can find at least 17 ways in which the ocean is important in our lives. Answers may be listed vertically or horizontally.



Z	T	R	C	V	S	C	F	H	I	K	M	J	W	X	S
B	V	E	C	J	K	O	K	I	O	D	I	N	E	X	W
P	E	C	O	N	O	M	Y	B	F	D	G	L	L	U	E
Y	T	R	M	B	V	M	D	S	A	Z	S	A	L	T	A
L	K	E	N	B	V	U	U	F	I	S	H	I	N	G	T
T	R	A	V	E	L	N	K	M	N	O	I	T	F	D	H
K	U	T	F	D	S	I	C	X	D	X	P	Z	R	M	E
J	U	I	N	M	B	C	Z	X	U	R	B	W	E	A	R
O	F	O	O	D	I	A	C	T	S	X	U	Z	S	G	G
B	L	N	I	O	P	T	O	R	T	U	I	R	H	N	G
S	J	N	M	Y	M	I	N	E	R	A	L	S	W	E	A
L	K	J	H	U	Y	O	K	B	Y	F	D	W	A	S	S
L	P	O	U	Y	W	N	U	H	T	R	I	Y	T	I	D
G	O	L	D	Y	T	R	H	G	F	D	N	K	E	U	X
S	H	E	L	L	F	I	S	H	T	Y	G	R	R	M	Q

WORD SEARCH KEY

RECREATION
COMMUNICATION
TRAVEL
INDUSTRY
SHIPBUILDING
FISHING
FOOD
ECONOMY
WEATHER

SALT
FRESH WATER
MAGNESIUM
IODINE
GOLD
SHELLFISH
MINERALS
JOBS

GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Importance to People
OUTCOME: 40. Discuss the importance of the ocean in our lives.

Background

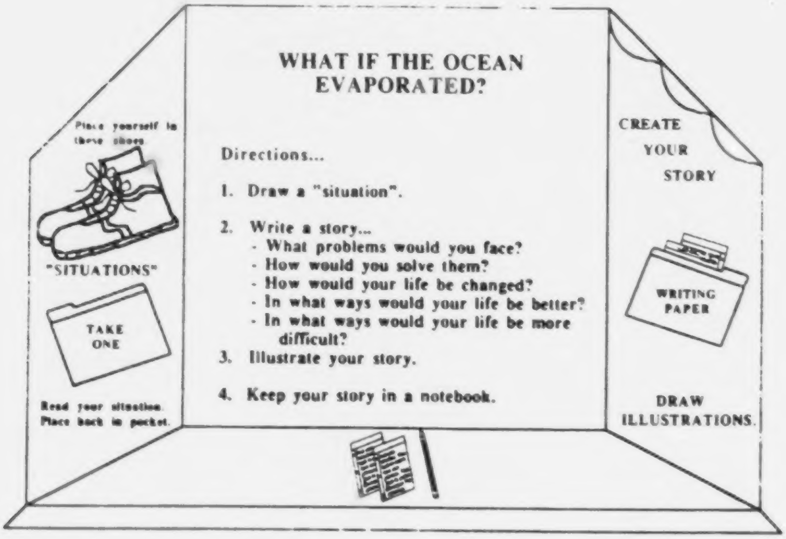
This activity may be used as a follow-up to a lesson on the importance of the ocean, allowing students to expand their concept of the importance of the ocean by encouraging them to think of varied reasons why people depend on the ocean. A learning-center approach to this activity can arouse students' interest and allow them to work independently. The learning center will accommodate two to three students.

Materials

- Tag board or cardboard
- Small table or shelf
- File folders (2)
- Markers

Procedures

1. Arrange a center similar to the one in the following illustration. Fold or cut tag board and tape it so that it stands with three sides.


WHAT IF THE OCEAN EVAPORATED?
Place yourself in these shoes
"SITUATIONS"
TAKE ONE
CREATE YOUR STORY
WRITING PAPER
DRAW ILLUSTRATIONS.

Read your situation. Place back in pocket.

Directions...

1. Draw a "situation".
2. Write a story...
   - What problems would you face?
   - How would you solve them?
   - How would your life be changed?
   - In what ways would your life be better?
   - In what ways would your life be more difficult?
3. Illustrate your story.
4. Keep your story in a notebook.

OUTCOME 40 (Continued)
Procedures (Continued)

2. Place title on center of tag board.

WHAT IF THE OCEAN EVAPORATED?

3. Write student directions, similar to the ones that follow, on center background.

Directions to Students

Examples:

- Select a "situation" from the pocket and read it. Be sure to replace the situation in the pocket.
- Write a story about what would happen if you were placed in a situation when the ocean evaporated. Think about these things...
  - What problems would you face?
  - How would you solve them?
  - How would your life be changed?
  - In what ways would your life be better?
  - In what ways would your life be more difficult?
- Illustrate your story.
- Keep your story in your notebook.

4. Write several "situations", similar to the ones that follow, on slips of paper to be selected from the pocket folders.

Possible "Situations"

You live on a small, tropical island far away from a continent.

You are on your way to Europe on a large ocean liner with enough supplies on board for one week.

You are the owner of a large fishing industry.

You are the Commander of the United States Navy.

You are a southwestern farmer who depends on desalinated ocean water for irrigating his crops.

You are the manager of a fleet of vacation cruise ships.

You are the owner of a very large motel on the gulf at Gulf Shores, Alabama or Panama City, Florida.

5. Staple a file folder on each side of the center.

OUTCOME 40 (Continued)
Procedures (Continued)

6. Place situations in one file folder and clean writing paper in the other.

7. Explain to the students that they must use their imaginations and try to place themselves in the situation they select. Encourage them to think of all the ways they would be affected in that imaginary situation if the waters in the oceans evaporated.

8. Communicate to the students that they are to write a story. Stress the idea that stories and illustrations may be completed during their spare time and that work will be kept in their notebooks.

Extensions

1. Create a bulletin board display with completed activities from the center.

2. Set aside a day near the end of the unit for students to read their stories to the class.

3. Compile students' stories and illustrations into a booklet for the class to enjoy. Share the booklet with students in a lower grade.

GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Life In the Ocean
OUTCOME: 41. Explain how salinity, temperature, depth, and light affect amounts and kinds of life in the ocean.

Background

This activity enables students to take an imaginary voyage to the bottom of the ocean for the purpose of observing sea life. Dialogue is provided to be used as narration during the imaginary trip. The narration may be read aloud during the lesson or recorded ahead of time, possibly with background music, and played as students complete booklets and pretend to be on a deep-ocean voyage.

Booklet pages may be copied and assembled ahead of time to form a tourist guide book in which the students can record observations during the trip. The activity requires a one-hour class period.

Materials

- Tape of narration (optional)

For each student:
- Crayons, colored pencils, or markers
- Handout: PASSPORT TO UNDERWATER ADVENTURE (pp. 1-4)

Procedures

1. Tape-record the narration provided in this activity, or have it recorded by an unfamiliar voice, pausing at appropriate times so that students have time to complete work in their booklets.

2. Make copies of the handout PASSPORT TO UNDERWATER ADVENTURE (pp. 1-4) and assemble a booklet for each student.

3. Distribute booklets and explain that the class is about to go on an imaginary voyage to the bottom of the ocean to observe plant and animal life. Explain that people who do this for a living are called oceanographers.

4. Discuss some of the factors that affect life in the ocean, such as salinity, water temperature, sunlight, and depth. Instruct students to notice how these factors affect the plant and animal life they will be observing.

OUTCOME 41 (Continued)
Procedures (Continued)

5. Review with students the directions on the first page of the booklet.

6. Start the tape and have students listen and work in their booklets when directed to do so. Allow ten minutes at each pause on the tape for students to label and color their booklets.

NARRATION
UNDERWATER ADVENTURE ABOARD THE NAUTILUX

Good morning, ladies and gentlemen, and welcome aboard the Nautilux, the world's most luxurious underwater cruise ship. This is your captain speaking to you from the control compartment of our amazing ship. The crew of the Nautilux and I hope that you are comfortable and ready to enjoy your voyage.

I direct your attention to the oxygen tanks in front of your seats. They are placed there for your safety in case of an emergency; however, the Nautilux is a very secure vessel. It is watertight and has walls of thick steel. The portholes which permit you to see out during the voyage are made of plastic six inches thick.

Searchlights will illuminate our surroundings as we descend, since seawater is a barrier to light. Usually not enough light penetrates beyond 450 meters to be visible to the human eye. The searchlights on the Nautilux are white lights containing all colors. These lights will allow you to see the color and beauty of the underwater world.

(Turn to page one of your booklet.)

Please fasten your seat belts as we begin our descent. First, we will be cruising along the rocky shore of the continental shelf. Through your portholes you will view many types of plants and animals. Of course, you must remember that there are also millions of tiny plants and animals known as plankton drifting near the surface of the water that you will not be able to see. These microscopic one-celled creatures are the food on which almost all living things in the ocean depend.

Notice the abundance of plants living near the surface. We will be descending about 50 meters. Observe the plants carefully because they do not live in deep, dark waters. They will thrive only where they can get sunlight needed to carry on photosynthesis.

As you peer from your portholes, on the far left you will see a variety of small kelp growing between the rocks. Just below the kelp are some interesting creatures called sea anemones. They look much like a plant, but are really animals. Below, near the bottom, grows another variety of seaweed, and on the sandy floor you will see some spiny sea urchins. Look up on the rocks and you will spot a crab, a starfish, some clams, and barnacles. As we look toward the left, we can see a jellyfish drifting about the sea floor.

The salinity, or amount of dissolved salts in the seawater, is average in this area of the ocean. There are about 35 parts of salt to 1,000 parts of water. In some areas of the ocean where the salinity is much greater, very few plants can grow.

The Nautilux will remain stationary at this point to allow time for you to label and color your observation.

(Pause tape.)
(Turn to page two of your booklet.)

The Nautilux will now be moving farther into the ocean to a depth of about 400 meters. Some light penetrates this far into the water, so you will see a few remaining plants. To the far left of your view from the portholes, notice the giant kelp. This amazing plant can grow up to 300 meters tall. A sponge is attached near the bottom of the rocks and a clown fish swims gracefully above the rocks. On the sea floor a lobster can be seen heading toward some sand dollars nestled in the sand. To the far right a brilliantly colored coral reef offers protection for many small fish. We are fortunate to have an octopus swimming into view just as we prepare to descend into the deep ocean waters along the continental slope.

We will delay our descent briefly so that you may label and color your observations.

(Pause tape here.)
(Turn to page three of your booklet.)

Ladies and gentlemen, we have now begun our descent to approximately one kilometer below the surface of the ocean. On the way down you will spot several dolphin chasing a school of smaller fish. They must think it is lunchtime! We might begin to get a bit hungry ourselves as we view the tuna swimming in our direction, but pleasant thoughts of food quickly vanish as a dangerous looking shark approaches our ship. Never fear; he is only curious and you are completely safe inside the steel walls of the Nautilux.

As we move deeper along the slope toward the abyssal plain, I believe we are about to be very lucky indeed. Coming into view at the bottom side of your portholes is a sperm whale. Notice that his enormous head makes up about one third of his body length. Sperm whales can grow to be 65 feet long and weigh 60 tons. They have 36 to 56 teeth in the lower jaw, and this one seems to be very proud of his. The Nautilux will stop here for a moment while you record your observations.

(Pause tape here.)
(Turn to page four of your booklet.)

We have now come to the portion of this voyage for which you have all been waiting. Our cruise ship is about to plunge into the deepest, darkest depths of the ocean. We will descend to a point on the ocean floor three kilometers below the surface where the water is cold, quiet, and mostly dark. Even though the water temperature at this level is extremely cold, the organisms which live here have adapted to it. The temperature of the water rarely varies more than five degrees at any time of the year.

The pressure of the water at this depth is tremendous and is another factor to which organisms of the deep must adapt. In the deepest parts of the ocean, the pressure reaches over seven tons per square inch. The Nautilux is built to withstand such pressures and so are the creatures of the ocean bottom. Pressure is not a problem for them because the pressure within their bodies is equal to the pressure outside their bodies. These organisms of the deep cannot venture far above the sea floor, however, because the change in pressure would kill them.

As we approach the sea floor, a giant squid appears in the center of our observation area. This ten-armed mollusk appears to be about 25 feet long. I certainly hope he does not consider us an enemy and squirt ink in our direction. His underwater smoke screen would hamper our observations. Swimming closely behind the squid are lanternfish guiding our way deeper still! These lanternfish and many other creatures of the deep are bioluminescent, which means they glow in the dark. They produce their own light which is similar to that of fireflies. The glowing helps these animals find food and attract mates.

The next organisms coming into view are perfect examples of the monster-like fish that live in the deep. These fish usually have large eyes, large mouths, and pouch-like stomachs. To the far left of your portholes, you can see a viperfish. He looks rather angry. To the right of the viperfish is a deep sea angler. A hatchetfish swims into view at the right side of your portholes and below on the bottom rests a brittle star.

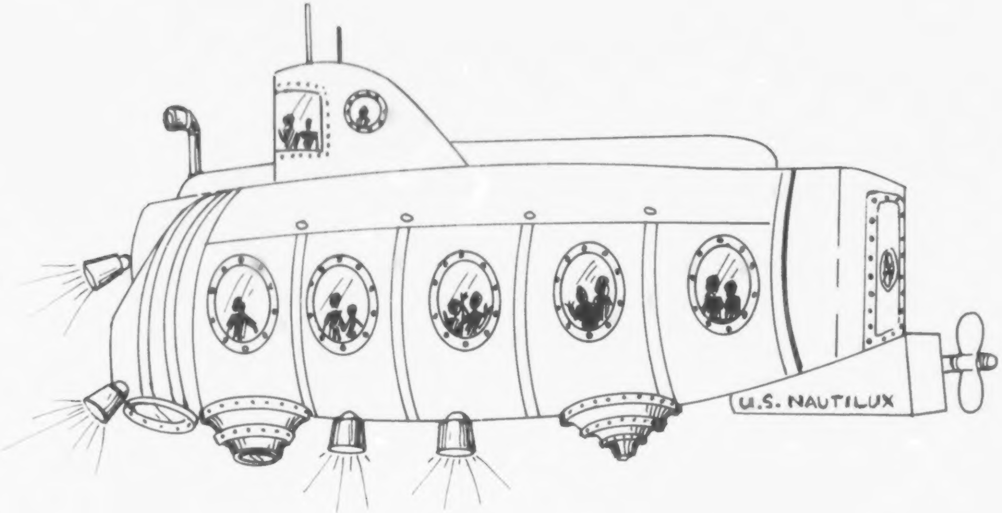
The Nautilux will rest on the ocean floor briefly so that you can complete your observations.

(Pause tape here.)

Ladies and gentlemen, our voyage to the ocean bottom has now come to an end, and we must begin our climb upward to the continent. As the captain of this deep-ocean vessel, I hope you have enjoyed your adventure. The crew and I extend an invitation to you to travel with us again in the future.

We are now approaching the dock. Thank you for your kind attention during the voyage.

Passport to Underwater Adventure

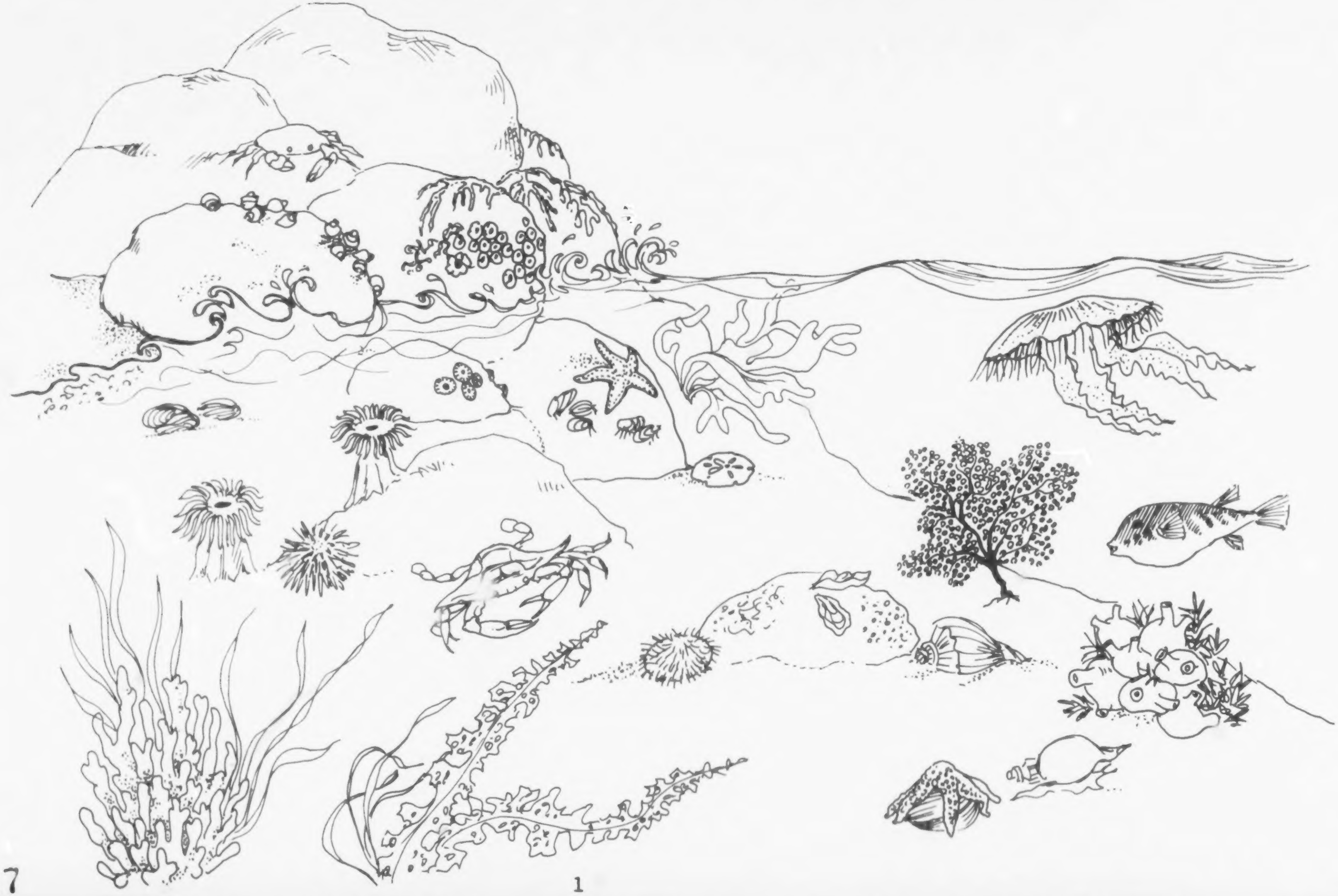


NAME____

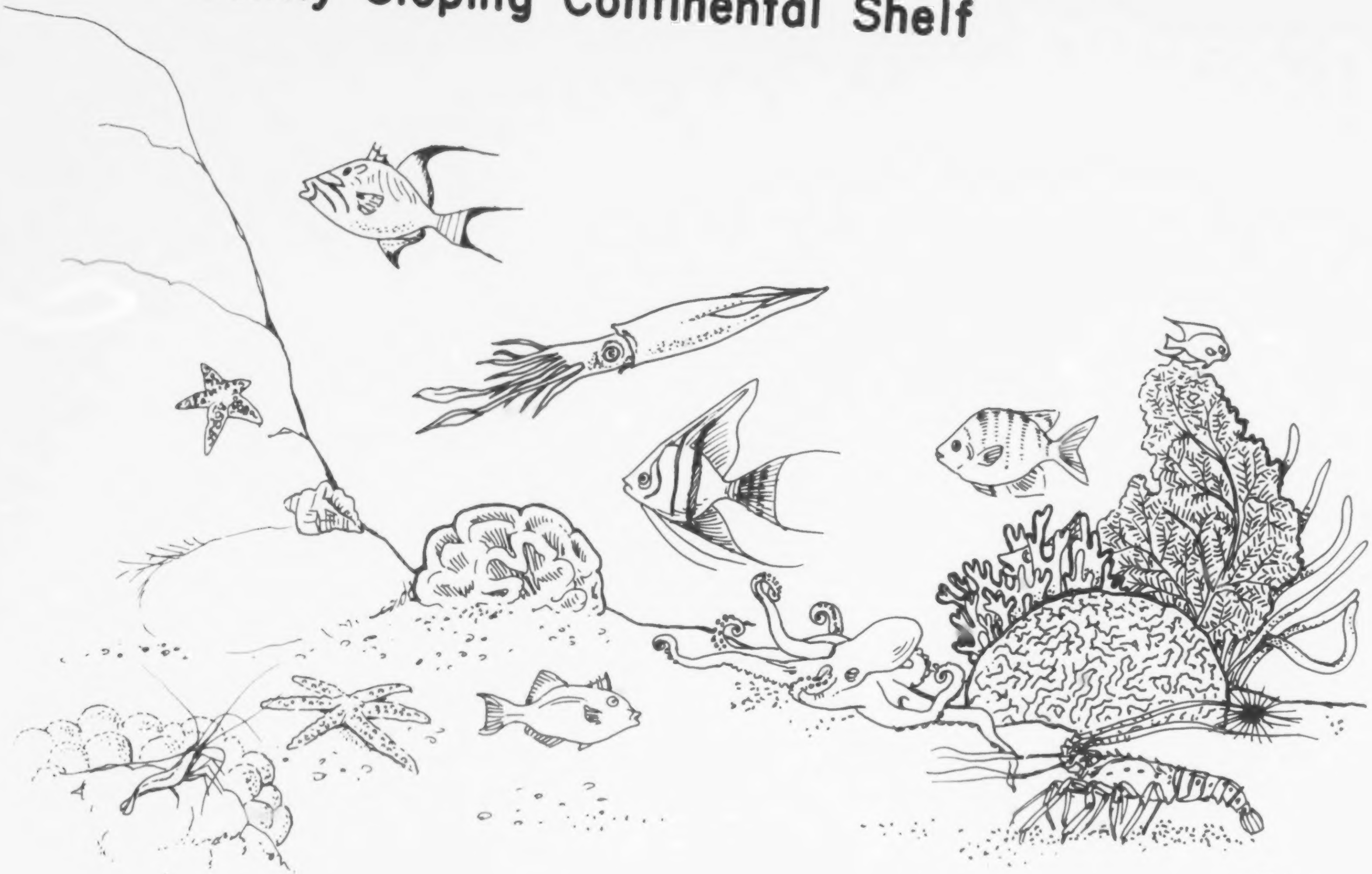
This passport entitles the holder to one round-trip voyage to the bottom of the ocean on the world's most luxurious deep-ocean cruise ship

THE U.S. NAUTILUX

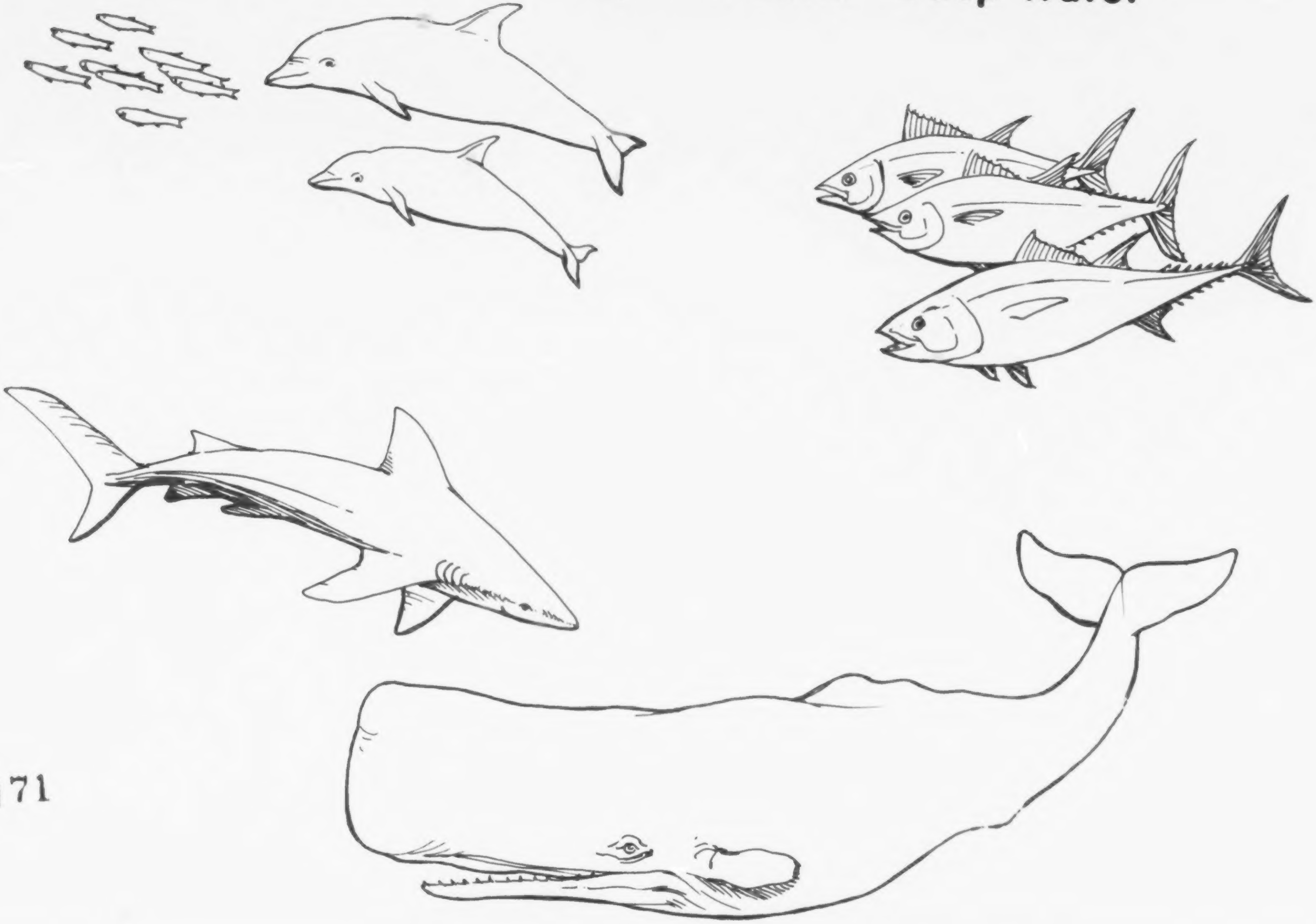
Shallow Water Along the Shore



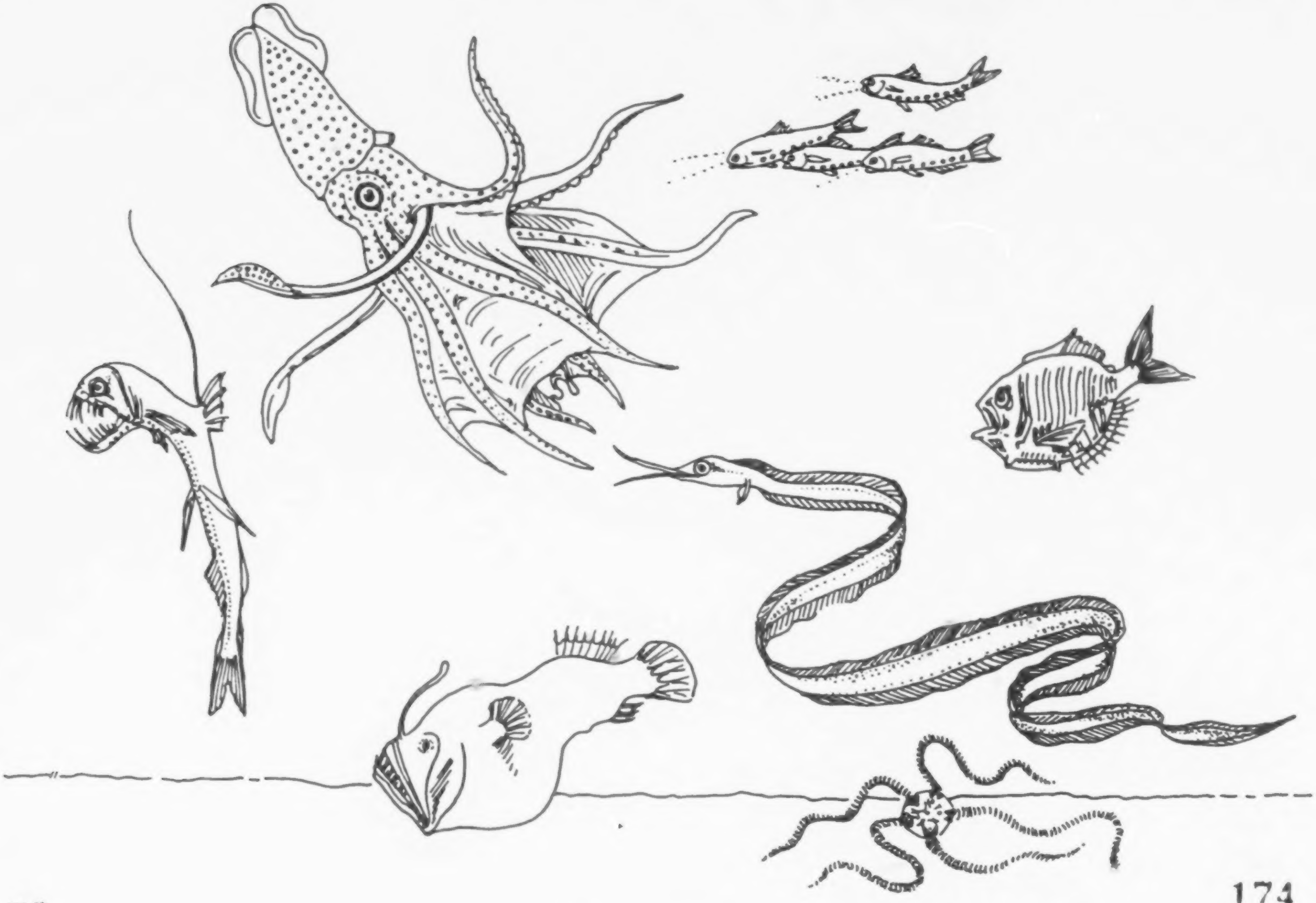
Gently Sloping Continental Shelf



Open Ocean- Deep Water



DEEP OCEAN AND BOTTOM DWELLERS



GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Underwater Exploration
OUTCOME: 42. Describe the geological formations and features found on the ocean floor.

Background

The four main geological features of the ocean floor are continental shelf, continental slope, the abyssal plain, and mid-ocean ridges. These four main features, along with some additional features found on the ocean floor, are defined below.

The CONTINENTAL SHELF is submerged land around many of the continents. The land gradually slopes under water to a depth of up to 600 feet (180 meters). The continental shelf can extend hundreds of miles. In some areas, the shelf barely exists. The shelf has rich oil fields and fisheries.

The CONTINENTAL SLOPE begins where the shelf comes to an end. The slope is much steeper, containing deep canyons that plunge to the bottom of the ocean floor.

The ABYSSAL PLAIN is the very deep, flat ocean bottom. These plains cover about a third of the sea floor.

MID-OCEAN RIDGES are mountains which extend upward from the sea floor. Mid-ocean ridges are found in all the major oceans of the world. Along the edges of the mountain chain on both sides are small foothills which become higher and steeper toward the middle of the ridge. Between the mountains are deep valleys. The deepest valley is located in the center of the ridge and is called the mid-ocean rift.

CANYONS are valleys or gorges in the continental slope, possibly carved by sediment washing into the ocean from the land.

TRENCHES are long, narrow valleys in the bottom of the ocean. They have steep walls on both sides. These trenches extend deep into the earth's crust. The deepest trench, called the Marianas Trench, is located in the Pacific Ocean and reaches a depth of 36,198 feet below the surface of the Pacific.

GUYOTS are underwater mountains that have flat table tops.

OUTCOME 42 (Continued)
Background (Continued)

This activity is designed for use after the geological features of the ocean floor have been introduced and discussed. The use of a variety of textbooks, filmstrips, transparencies, charts, graphs, and other resources will be helpful in preparing students for this activity. Students will create models of the ocean floor. The definitions given may be placed on the chalkboard or transferred to a student handout. The time allotted for the activity will depend on the amount of instruction and discussion needed before beginning the activity. The activity will require at least sixty minutes.

Materials

For each group:
- Baking dish, metal, 13" X 9"
- Modeling clay, non-hardening plastic (24 oz.)
- Toothpicks (10-12)
- Felt marker, fine tip and waterproof
- Water
- Food coloring, blue (optional)
- Labels, self-sticking

Procedures

1. Conduct a class discussion about the geological formations and features found on the ocean floor.

2. Explain that students will be working in small groups. Explain that each group will create a model of the ocean floor that will contain examples of geological features previously discussed, and each feature will be labeled.

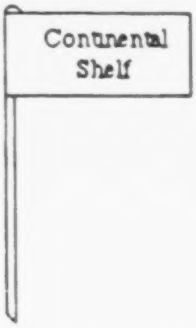
3. Divide the class into groups of three or four students.

4. Distribute to each group a baking dish, modeling clay, ten to twelve toothpicks, self-sticking labels, and a colored felt-tip marker.

5. Direct students' attention to the toothpicks and labels, and explain that before beginning the activity the label "flags" must be constructed. Instruct each student in each group to select one toothpick and peel off one label. Have students hold the label with the sticky side up, and place one end of the toothpick in the center of the label, perpendicular to the label. Instruct students

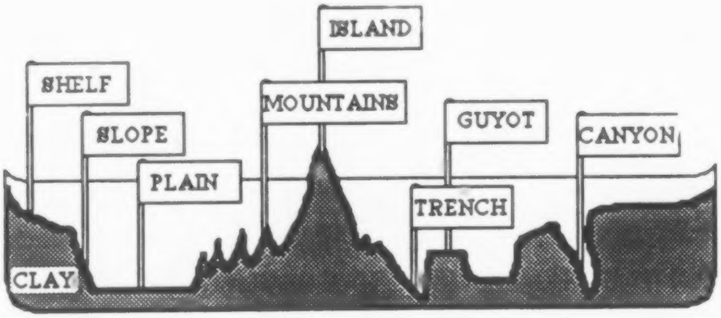
OUTCOME 42 (Continued)
Procedures (Continued)

to fold sides of the label together, matching the ends evenly, to form a "flag."



6. Instruct each group to finish making the "flags" and explain that they will label each "flag" with a geological feature, using the colored felt-tip marker. Explain that the pointed end of the toothpick will be placed in the clay to label features after the completion of the clay model.

7. Direct the students' attention to the baking dish and clay. Explain that each group will construct a model of the ocean floor as directions are given. Instruct groups to place clay in the baking dish and build the clay on each end of the dish almost to the top to form the shoreline and continental shelf. Instruct them to shape the clay downward toward the center of the dish to form the abyssal plain. Explain that the abyssal plain will have only a thin layer of clay covering the bottom of the dish. Have the groups continue their creations of the various features of the ocean floor. Remind them that these include mountains, valleys, guyots, trenches, canyons, and possibly a very high mountain extending above the shoreline that will form an island when water is added.



OUTCOME 42 (Continued)
Procedures (Continued)

8. Instruct groups to add water to their models after features and labels are complete. Have students add a few drops of food coloring to the water for a more realistic result.

9. Allow each group to share its project with the class. Display all work in an undisturbed area.

GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Underwater Exploration
OUTCOMES: 42. Describe geological formations and features found on the ocean floor.

43. Describe special types of equipment necessary for underwater exploration.

Background

The floor of the ocean is not flat and smooth, but is much like dry land with mountains, valleys, and canyons. Each continent is bordered with a shelf which extends outward into the ocean and is generally flat and gently sloping. This beginning of the ocean floor is called the continental shelf. The gentle slope of the continental shelf changes to a steep incline at the edge of the continent, sweeping downward sharply to the full depth of the deep ocean. This steep drop is called the continental slope. At the bottom of the ocean the land is very flat and is called an abyssal plain. These plains cover about a third of the sea floor. Rising out of the sea floor are mountains of every size. Some are simple hills, and some are so high that their peaks are above the surface of the ocean, forming islands. Sometimes the underwater mountains have a very flat table-like top. These features are known as guyot.

Another feature found on the floor of the ocean is a trench, or deep crack with cliff-like walls. Trenches extend very deeply into the earth's crust.

Before the invention of the echo sounder, scientists really did not know much about the ocean floor. Today oceanographers, scientists who study the ocean, use this device to help them map the ocean and learn more about the various geological formations found there. An echo sounder uses the echoes of sounds to explore the ocean floor. Sound waves are sent from a ship, reflected from the ocean bottom, and registered by an echo recorder on board the ship. The sound travels through the water at nearly one mile a second. As the sound returns and is registered by the echo sounders, the instrument records the echo as a dark mark on special paper. This continuous profile shows the scientists exactly what the ocean floor looks like.

This activity will strengthen the concept of the irregularity of the ocean floor when used after the major geological features of the floor have been introduced. The activity requires only one class period, but should be preceded by

OUTCOMES 42 and 43 (Continued)
Background (Continued)

the use of several visual aids (charts, models, bulletin boards) depicting the ocean floor and a review of graphing with students finding coordinates and plotting points. A key to the student handout PROFILE OF THE OCEAN FLOOR and a sample of the completed graph are included.

Materials

For each student:
- Graph paper
- Handout: PROFILE OF THE OCEAN FLOOR

Procedures

1. Conduct a review of the geological formations and features found on the ocean floor. Use as many pictures and representations as possible.

2. Discuss echo sounders with the class. Explain that these devices make it possible for oceanographers to map the ocean floor. Remind students that oceanographers are scientists who study the ocean.

3. Instruct students to pretend that they are oceanographers assigned the task of mapping an unknown area of the ocean floor. Have them pretend they are aboard a huge ship equipped with many instruments and tools used in underwater exploration. Explain that they will be recording a graph of the ocean floor through the aid of an echo sounder.

4. Distribute one sheet of graph paper and one worksheet per student, and direct students to use pencils for this activity.

5. Explain that before the oceanographers can begin work, they must prepare graphs for action. Instruct students to turn graph paper sideways with holes at the top edge. Have them begin by numbering across the bottom of their papers, starting three squares up and three squares across from the bottom left corner. Direct students to number the first line with a zero and continue numbering across the page to number 50, placing numbers on each line. As they number the graph upward, have them begin with zero and continue numbering to 30.

OUTCOMES 42 and 43 (Continued)
Procedures (Continued)

6. Instruct students to draw a horizontal wavy line across line 20 of their graphs to represent the water level.

7. Announce that student oceanographers are now ready to begin recording the information from the echo sounder. (This is found on the handout PROFILE OF THE OCEAN FLOOR.) Direct students to plot points and draw lines connecting points.

8. Instruct student oceanographers to label their graphs upon completion, using the list of geological features found on the handout.

PROFILE OF THE OCEAN FLOOR
Handout

1. Plot the following coordinate points on your graphs.

0,20
2,20
3,19

8,19
10,19
11,18
11,16
12,15
12,13
13,12
13,10
14,9
14,6
15,5
16,4
23,4
24,5

25,4

26,6
27,7
28,6
28,9
29,10
29,13
30,14
30,16
31,17
31,19
32,20
33,21
34,20
35,19

35,16
36,17
37,16
37,14
38,13
38,5
37,4
41,4
42,2
42,1
43,0

44,2
44,3
45,4
45,6
46,7
46,8
49,8
49,6
50,5
50,2

2. Draw lines connecting points.

3. After completing your graph, label your profile of the ocean floor using the following geological features.

Land
Continental Shelf
Continental Slope
Abyssal

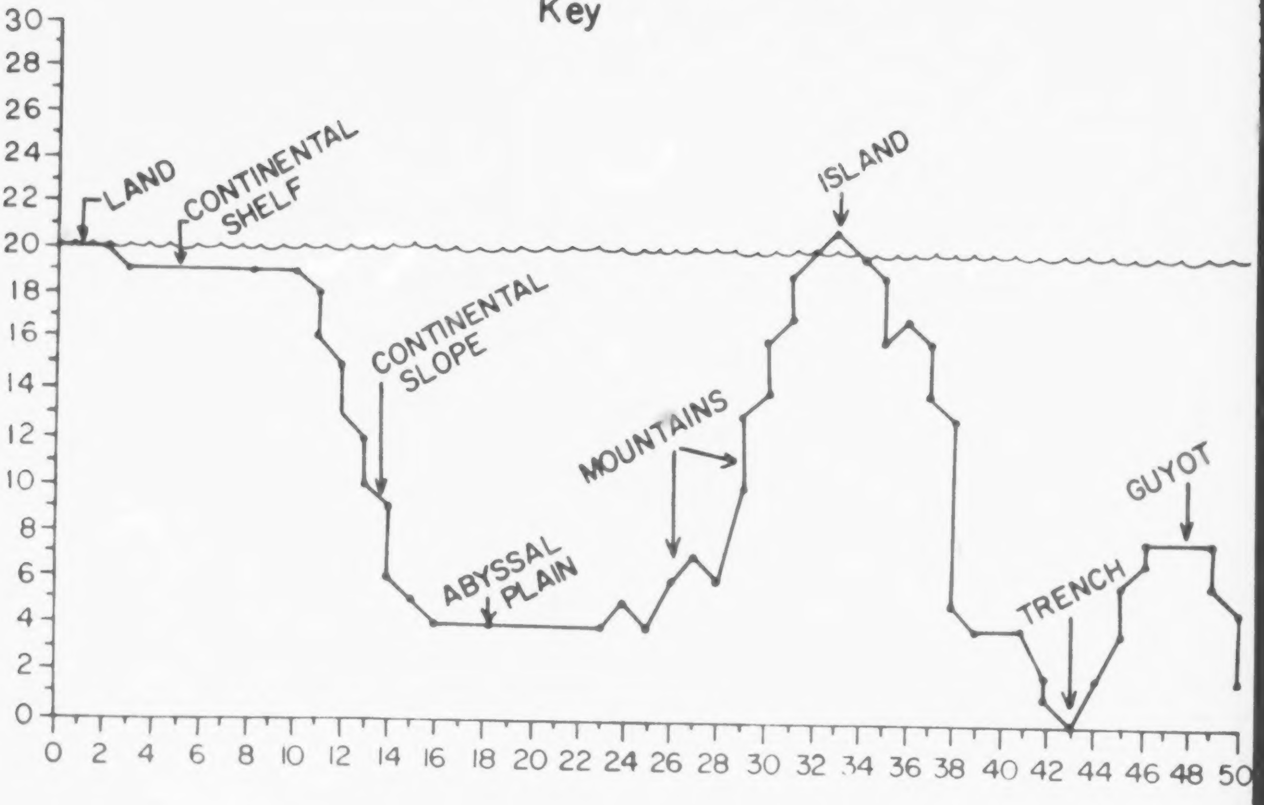
Mountains
Island
Trench
Guyot

4. Classify each feature. List under the proper category below.

Features Extending Above Sea Level	**Underwater Features Extending Above The Ocean Floor**	**Underwater Features Extending Below The Ocean Flloor**

PROFILE OF THE OCEAN FLOOR

Key



4. Classify each feature. List under the proper category below.

Features Extending Above Sea Level	Underwater Features Extending Above The Ocean Floor	Underwater Features Extending Below The Ocean Floor
Land	Continental Shelf	Trench
Island	Continental Slope	
	Mountains	
	Guyot	

GRADE 5
EARTH SCIENCE

UNIT: Oceanography
TOPIC: Underwater Exploration
OUTCOME: 43. Describe special types of equipment necessary for underwater exploration. (Also addresses outcome on career awareness.)

Background

This activity allows students to play a simulation game in which they learn about the work of various types of oceanographers as they match the special scientists with the tools needed for their specialized tasks. Students must have previously identified tools of oceanography and must be aware that an oceanographer is a scientist who studies the ocean. The activity may be arranged in a center for small groups, or may be adapted for use with the class, in which case copies of the game board and multiple sets of the game cards will be needed. Laminate the game board and cards, if possible. Directions are given at the end of the activity. The game may be adapted to last from fifteen to forty-five minutes.

Materials

- Index cards, 3" x 5 " (64)
- Game Board: LET'S STUDY THE OCEAN
  CAREER CARDS
- Handout: DIRECTIONS FOR PLAY
- Handout: BOAT PATTERN

For each group:
- Die
- Boat shaped markers (4)

Procedures

1. Glue the two pages of the game board inside a file folder.
2. Label five 3-by-5-inch index cards for each of the following: Biological Oceanographer, Geological Oceanographer, Chemical Oceanographer, and Physical Oceanographer.
3. Number each group of five career cards one through five. (The numbers on the cards indicate points, which will determine who wins. There are 20 "career" cards.)

OUTCOME 43 (Continued)

Procedures (Continued)

4. Make four cards for each of the following: plankton net, drift bottle, corer, Nansen water samper bottle, echo sounder, bathysphere, current meter, current-measuring buoys, trawl net, pickling bottle, and "SUPER EQUIPMENT" (40 equipment and 4 "SUPER EQUIPMENT" cards.)

5. Shuffle all cards to make one deck. (These three types of cards determine the following moves: play, career, equipment, and "SUPER EQUIPMENT.)

6. Use the boat pattern and cut markers from poster board for all players.

7. Provide one deck of cards, a game board, directions for play, and one die for each group of students or for a learning center.

8. Direct students' attention to the four careers in oceanography defined on the game board, and explain that the groups will match the career cards with the equipment cards representing tools used in that particular career.

9. Discuss the directions for play, and direct students to begin the game.

DIRECTIONS FOR PLAY
Handout

1. Two to four players may play at one time. Start the game by deciding how many trips around the board will make a voyage. Give each player a boat marker, shuffle the deck, deal five cards to each player and put the remaining cards facedown in a pile. This is the draw pile. Place one card, faceup, next to this pile to start the discard pile.

2. The game begins with the player to the left of the dealer. The first player takes the top draw card or the top card from the discard pile and makes any matches possible by matching career cards to equipment cards. (The higher the number of the career card, according to the chart on the game board, the more valuable the match.) "SUPER EQUIPMENT" cards will match any career. The player displays the matches beside the board. Then the player draws to return his or her hand to five cards, but no more matches can be made at this time. If there are no cards in the discard pile, the top card from the draw pile will be turned over to renew this pile.

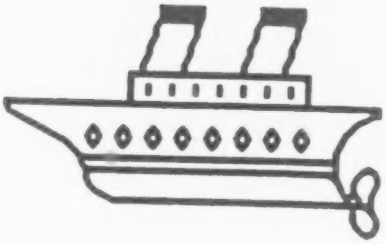
3. To complete a turn, the player rolls the die, moves his or her marker the number of spaces indicated on the die and follows any instructions given in the game board block. Play continues to the left.

4. If the draw pile runs out during the course of the game, shuffle the discard pile, making it the new draw pile, and turn one card up to restart the discard pile.

5. At the end of the voyage, the player with the highest number of points is declared the winner.

196

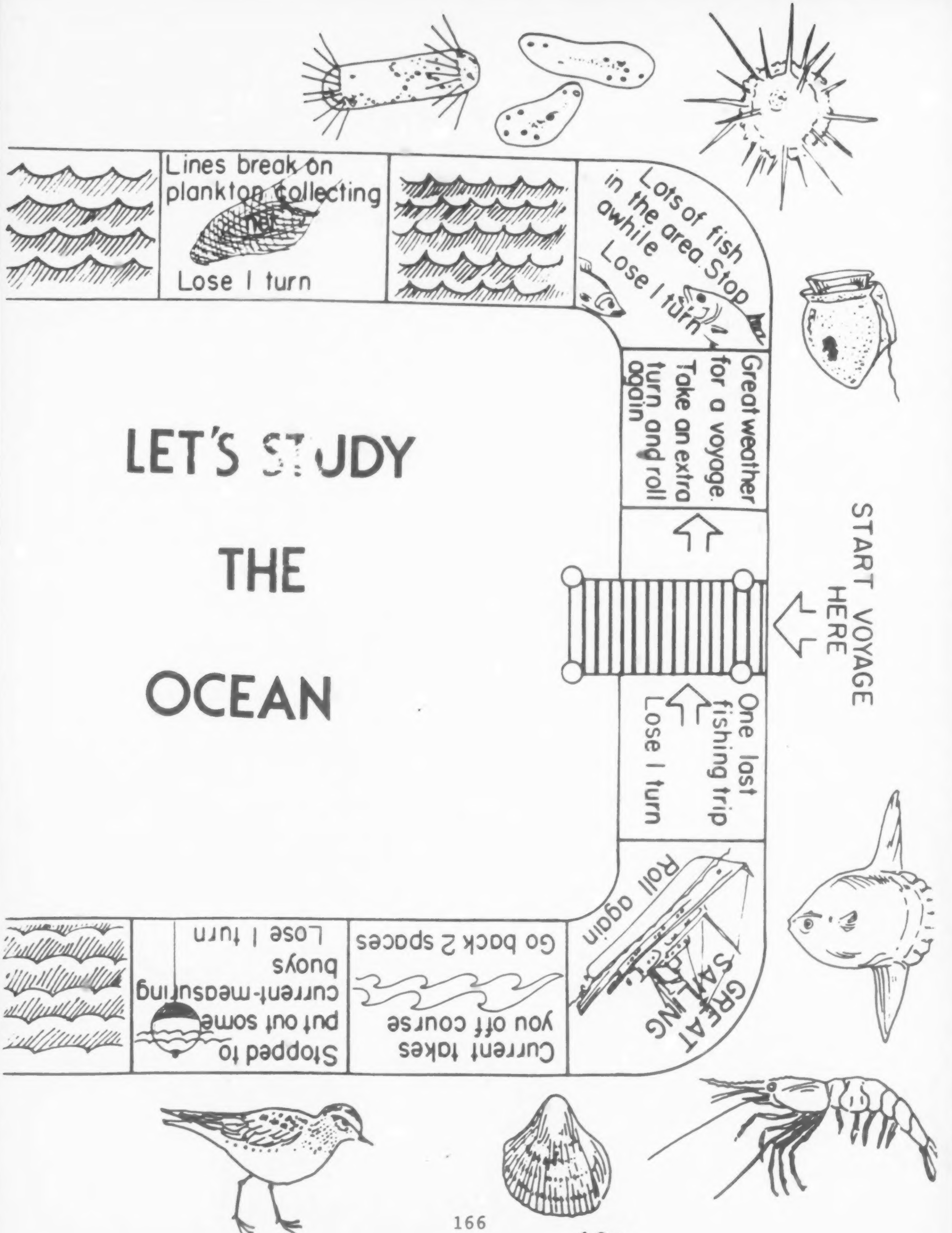
BOAT PATTERN
Handout



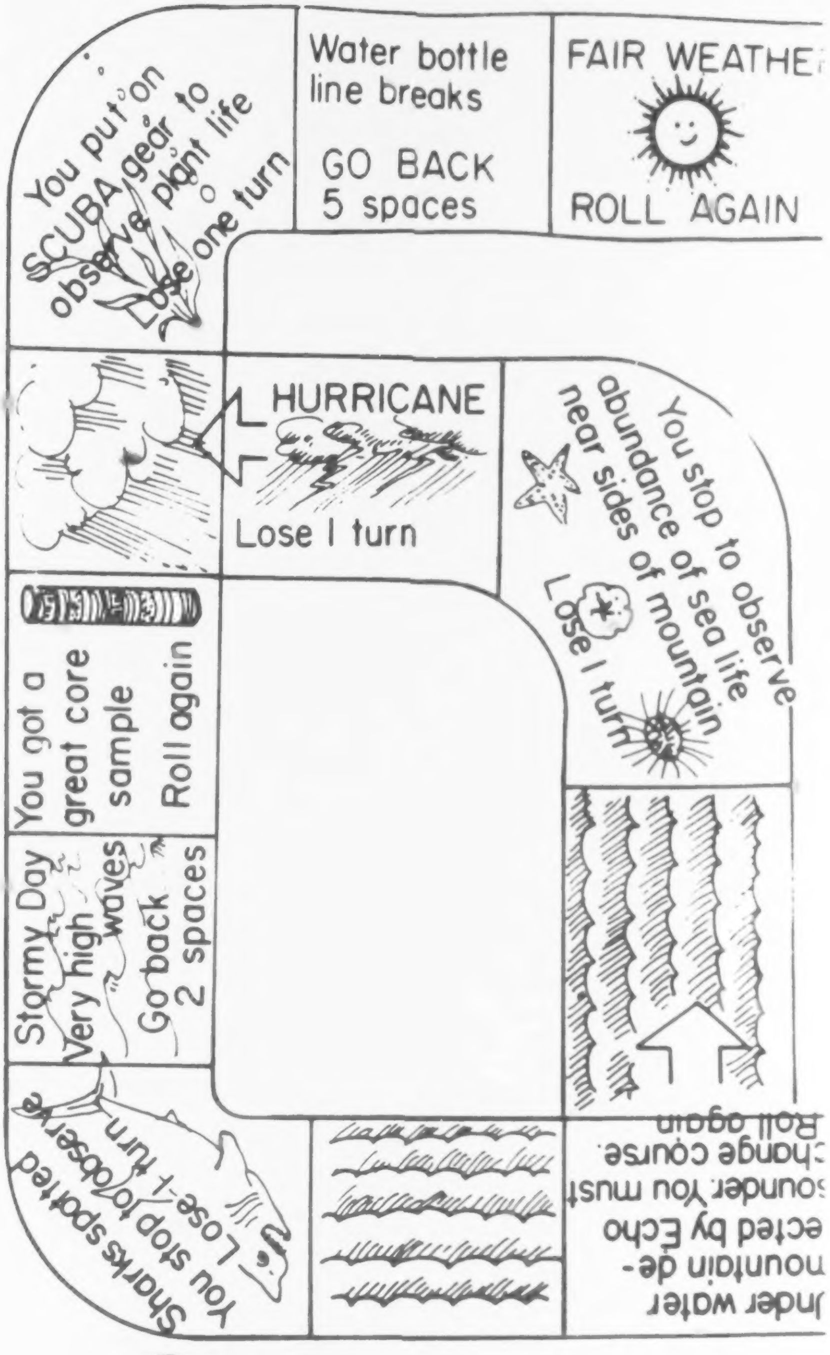
LET'S STUDY

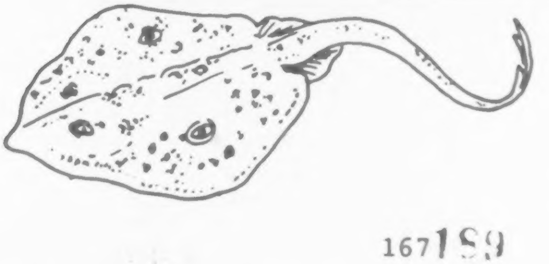
THE

OCEAN

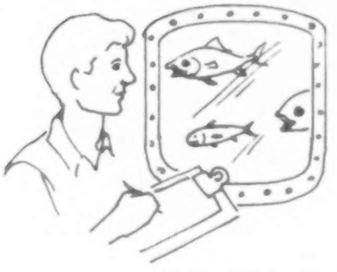

START VOYAGE HERE
Great weather for a voyage. Take an extra turn and roll again
Lots of fish in the area. Stop awhile Lose 1 turn
Lines break on plankton collecting
net
Lose 1 turn
One last fishing trip Lose 1 turn
Roll again
GREAT SAILING
Current takes you off course Go back 2 spaces
Stopped to put out some current-measuring buoys Lose 1 turn

LET'S STUDY THE OCEAN


You put on SCUBA gear to observe plant life
Lose one turn
Water bottle line breaks
GO BACK 5 spaces
FAIR WEATHE
ROLL AGAIN
HURRICANE
Lose I turn
You stop to observe abundance of sea life near sides of mountain
Lose I turn
You got a great core sample
Roll again
Stormy Day
Very high waves
Go back 2 spaces
Sharks spotted
You stop to observe
Lose 1 turn
nder water
nountain de-
ected by Echo
ounder. You must
hange course.
Roll again

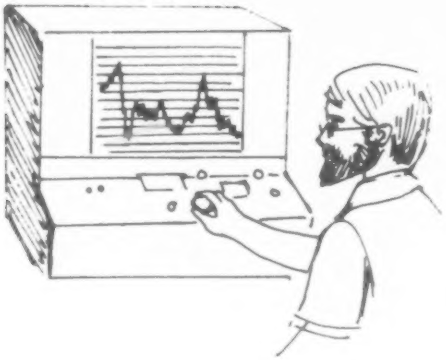


CAREER CARDS



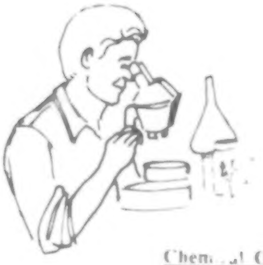
Biological Oceanographers

are often called marine biologists; they study plants and animals which live in the ocean.



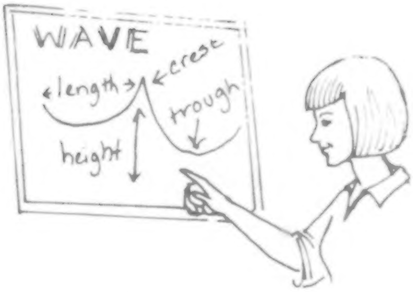
Geological Oceanographers

study the ocean floor, its composition and physical features. They map the ocean floor and take core samples.



Chemical Oceanographers

test and study the compostion of the sea water. They test to find elements such as chlorine, sulfur, bro[illegible] [illegible] and calcium.



Physical Oceanographers

are concerned with studying tides. waves, currents, density and salinity of the sea. They also measure ways light and sound travel in the ocean.

Making a Match

Scientists	Equipment
Biological Oceanographer	plankton net, trawl net, pickeling bottle, bathysphere
Geological Oceanographer	corer, echo sounder
Chemical Oceanographer	Nansen bottle water smapler
Physical Oceanographer	current buoys, current meter, echo sounder, drift bottle

BEST COPY AVAILABLE

GRADE 5
EARTH SCIENCE

UNIT: The Land and Its Resources
TOPIC: Layers of Earth
OUTCOME: 44. Describe three layers that compose the earth.

Background

The interior of the earth has three main parts. The innermost part is called the core. It is about 4,400 miles in diameter. It is made of very dense material, which at the very center may reach a density of 600 pounds per cubic foot. Surrounding the core is the mantle, a layer of solid rock about 1,800 miles thick. Outside the mantle is the crust, which is from 3 to 25 miles thick. The crust is less dense than the mantle. Some parts of the mantle contain magma.

This activity needs to be implemented over several days to allow time for the mantle layer to dry.

Materials

- Clay, pottery (1 to 3 lbs.)

For each student:
- Rock, approximately 5 in. in diameter
- Clay, modeling (1/2 c.)

Procedures

1. Tell students that they will make a model of the earth. Explain that a medium-sized rock is needed for the core, since this is the densest part of the earth. Have students search the school yard for sufficient rocks, or have students bring them from home.

2. State that the pottery clay will represent the mantle of the earth. Explain that it should be approximately half as thick as the core to keep the proportions correct. Have students spread the clay over the rocks and mold the clay with their hands. Let this dry overnight or longer until it is hard to the touch.

3. Explain that modeling clay will represent the crust of the earth. Have students spread the modeling clay thinly over the pottery clay. Tell students that the clay does not need to be smooth, just as the earth's surface is not smooth. Have students include mountains and valleys, as they wish.

GRADE 5
EARTH SCIENCE

UNIT: The Land and Its Resources
TOPIC: Layers of Earth
OUTCOME: 45. Identify common materials that contain matter from the earth's crust.

Background

The earth's lithosphere, the outer layer, is commonly called the crust. It extends to a thickness of 48 kilometers. In some areas it may be three kilometers thick, while in other areas it may be thicker. The earth's usable resources can be obtained from the crust; therefore, the earth's crust is composed of matter. Matter taken from the earth is used by the people of Earth to help them survive. Food, clothing, building materials, and matter used for energy all come from the earth. Some matter from the earth is nonrenewable, while some matter is renewable. Conservation of the earth's nonrenewable natural resources is essential for survival on the planet.

Prior preparation for this activity will require a bulletin board with the title "Substances from the Earth's Crust." Two labels will be needed "Renewable Substances" and "Nonrenewable Substances."

Materials

- Prepared bulletin board

For each student:
- Magazines, a variety
- Scissors

Procedures

1. Discuss with the students that matter from the earth's crust is anything that consumes space and has mass. Tell students that these substances form the living and non-living materials of Earth.

2. Ask students to think of living substances found on the earth's crust. List these substances on the chalkboard under the heading "Living Substances."

3. Have students think of substances on or within the earth's crust that are classified as non-living. List these on the chalkboard under the heading "Non-living Substances."

OUTCOME 45 (Continued)
Procedures (Continued)

4. Direct students to observe the list and identify the living and non-living substances that are not renewable (fossil fuels, minerals, and metals).

5. Ask students to identify the living and non-living substances that are renewable (plants and animals as long as reproduction exceeds demand, and the quantity of water, air and soil).

6. Instruct the students to look carefully at different objects in the classroom.

7. Have students identify the substances used to make each specific object. Identify each substance as renewable or nonrenewable.

8. Distribute magazines and scissors to the students.

9. Tell students to look for common materials containing matter from the earth's crust (cans, glass, metals, paper products, plastics, fertilizer, medicine, food, and others).

10. Ask students to cut out the pictures and staple them to the bulletin board under the appropriate headings.

Substances from the Earth's Crust	
Renewable substances	Nonrenewable substances
(Pictures of	Common Materials)

11. Use the bulletin board to review the common materials that contain matter from the earth's crust. Emphasize the fact that some substances are nonrenewable and others are renewable. Tell students that careful management and conservation will help spread limited resources.

GRADE 5
EARTH SCIENCE

UNIT: The Land and Its Resources
TOPIC: Physical Features
OUTCOME: 46. Explain how external forces can cause changes in the earth's crust.

Background

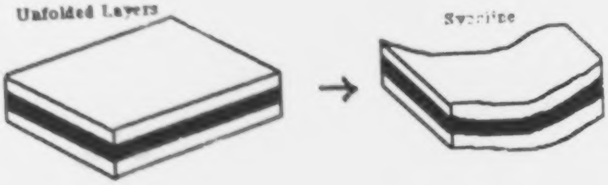
Layered clay blocks represent rock layers in this activity. When the blocks are pushed in on each end with hand pressure, the layers fold or arch upward. The arch is apt to break or crack near the center. This represents what rock layers in the earth do when pressure is applied from the side. Weathering takes place where the cracking occurs. Canyons form in the cracks from erosion. When one side is moved up, the layers are no longer continuous, which causes a fault. This faulting may bring rocks from within the earth to the surface. Many mountain areas have been produced by this type of faulting.

Materials

- Modeling clay, several colors

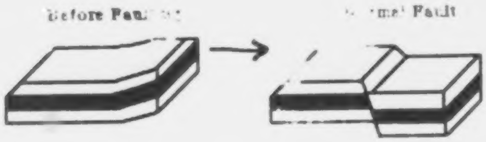
Procedures

1. Assign students to small groups.
2. Explain to the students that changes in the earth's surface occur due to folding and faulting. Discuss the terms folding and faulting with students.
3. Explain to the students that they are going to make a model of rock layers.
4. Direct the students to place several different colors of modeling clay on top of each other.
5. Direct the students to push in on each end with their hands. This pressure will cause the layers to fold or arch upward. Explain that canyons form in the cracks.



OUTCOME 46 (Continued)
Procedures (Continued)

6. Instruct the students to make a cut in the clay, through the center of the layers. Direct them to move one side up, causing a fault. Explain that many mountains have been produced by this type of faulting.



7. Have students write a paragraph to summarize what happened during the experiment.

GRADE 5
EARTH SCIENCE

UNIT: The Land and Its Resources
TOPIC: Rocks
OUTCOME: 47. Describe properties of rocks.

Background

Rocks are classified according to their properties. All rocks that are formed from hot magma are called igneous whether they are cooled above or below the earth's surface. Rocks are made of one or more minerals that have combined in different ways and in different amounts. Some examples of igneous rocks are granite, obsidian, and basalt. Sedimentary rocks are formed from layers of broken rock, minerals, and dead animals and plants. Just as there are many different kinds of matter that compose the sediment, there are different kinds of sedimentary rocks that have been formed from layers of sediment squeezed together under great pressure. Some examples of sedimentary rocks are limestone, sandstone, and shale. Both igneous and sedimentary rocks can be changed by heat and pressure into a different kind of rock called metamorphic rock. Examples of this smooth, hard rock are marble, slate, and gneiss.

A large number of rocks are needed for this activity. Ask the students to bring some from home, or to go on a "rock hunt" to secure samples. You may wish to provide some unusual specimens, if they are available to you.

Materials

- Pictures of identified rocks

For each group:
- Rocks
- Hand lens
- Water
- Vinegar (few drops)

For each student:
- Paper (one sheet)
- Handout: IDENTIFYING ROCKS

Procedures

1. Assign students to groups of four or five.

2. Explain to students the three main groups of rocks and their characteristics. Write the names of the groups on the chalkboard. Show pictures or samples.

OUTCOME 47 (Continued)
Procedures (Continued)

3. Have the students identify the different rocks they have collected. Each group should be given some of the rocks to examine with the hand lens.

4. Distribute to each student the handout IDENTIFYING ROCKS and a sheet of paper paper. Direct the students to identify the rocks based on the descriptions on the handout IDENTIFYING ROCKS. (Direct the students to write the rock type on a sheet of paper and place the rock in the middle of the sheet when the rock has been identified.) Direct them to continue working until all samples have been identified or until the assigned time has passed.

5. Display all rock identifications, grouping the rocks to igneous, sedimentary, or metamorphic identifications. Allow the groups time to explain at least one of their identifications, if possible.

6. Ask a "rock specialist" to visit the classroom and classify the rocks.

IDENTIFYING ROCKS
Handout

1. Granite: Specks of pink, grey, black, or white are distributed throughout (like salt and pepper). Feldspar (a gray or pink color), mica, and light-colored quartz are observable, although tiny, and all specks are about the same size. Look for the specks to identify granite.

2. Obsidian: Smooth as glass and black. This rock cools quickly. Indians used obsidian to make arrowheads and hunting tools. Look for a smooth, black, glass-like rock.

3. Basalt: A hard, dark-colored igneous rock. It is made of lava that cooled slowly, allowing time for tiny mineral crystals to form inside. (Not as smooth or glass-like as obsidian.)

4. Sandstone: Usually reddish or brown (but may be gray or yellowish in color) chunks of rock. Try to scrape two samples together over a newspaper, breaking off tiny grains of sand if possible. Sandstone is made mostly of quartz and sand.

5. Shale: A flat, soft, gray (may be red or brown) rock that is layered. It can be scratched with a penny. Wet shale smells like damp earth, so pour water on it.

6. Limestone: Usually gray or white. Since limestone is made mostly of calcite, a weak acid will dissolve it. Pour a few drops of vinegar on the rock to verify an identification.

7. Marble: A smooth metamorphic rock formed from limestone that has many tiny, shiny crystals.

8. Slate: A hard, smooth, metamorphic rock formed from shale.

9. Gneiss: A metamorphic rock formed when granite is heated under great pressure under the earth. The minerals in granite melt together and cool, forming bands of color.

GRADE 5
EARTH SCIENCE

UNIT: The Land and Its Resources
TOPIC: Minerals
OUTCOME: 48. Explain that natural elements or compounds in the earth's crust are minerals.

49. Identify minerals by testing their properties.

TOPIC: Conservation
OUTCOME: 50. Explain why some minerals are in short supply and what should be done to conserve them.

Background

A mineral is defined as any natural element or compound found in the earth's crust. Some minerals contain only one element while others are compounds and contain two or more elements.

Geologists look at certain properties to identify common minerals. These properties are color, hardness, and luster. Some of the common minerals are quartz, talc, gypsum, diamond, feldspar, and topaz.

Some minerals are already in short supply, and people feel that an effort should be made to conserve them. Cans and bottles made from minerals are often discarded. Aluminum cans and glass bottles are usually thrown away, yet there are collection agencies all across our country that collect such minerals for recycling. Recycling provides a method for transforming melted cans and bottles into new cans and bottles.

In this activity, students bring mineral samples they find outside the classroom or the mineral samples may be ordered from a scientific supply catalog. Students classify minerals according to weight, color, smoothness, and hardness.

The INSTRUCTIONS need to be reproduced and placed on six 5" by 8" index cards. The MINERALS IDENTIFICATION MATERIALS LIST needs to be reproduced and glued to each shoe box.

OUTCOMES 48, 49, and 50 (Continued)
Background (Continued)

Instructions

1. Using the handout MINERAL IDENTIFICATION, begin to test for all categories. Use the mineral collecting books to help complete each category.
    a. WEIGHT - Use the scale to weigh the mineral. Record the findings.
    b. COLOR - Record the color.
    c. COLOR STREAK - Rub the mineral across the streak plate. Record the findings.
    d. SMOOTHNESS - Smooth +, rough -. Record the smoothness.
    e. HARDNESS - Use the scale 1-10.
2. Test all minerals at the station.
3. After all categories are completed, make a guess about the mineral's identity.

MINERALS IDENTIFICATION MATERIALS LIST

- At least six different mineral samples labeled A-E
- At least one mineral collecting book
- Pennies
- Knife
- Quartz sample
- Topaz sample
- Streak plate (white, unglazed tile)
- Metric scale (If only one is available, place it in a central location for all groups.)
- Instructions written on 5" x 8" index cards
- Chart: HARDNESS SCALE
- Chart: HARDNESS TEST

Materials

For each student:
- Handout: MINERAL IDENTIFICATION

For each group:
- Books about mineral collecting with a color guide (at least 1)
- Samples of minerals (at least 6)
- Shoe box
- Unglazed porcelain - the rough back of a section of bathroom tile
- Tools for hardness test:
    - pennies
    - knife
    - piece of glass
    - samples of quartz
    - samples of topaz

OUTCOMES 48, 49, and 50 (Continued)
Materials (Continued)

- Metric scale (If only one is available, place it in a central location for all groups.)
- Instructions on 5" x 8" index cards

Procedures

1. Place all of the items listed as a part of the MINERALS IDENTIFICATION MATERIALS LIST at each of six stations. Place as many items as possible in a shoe box at each station.

2. Explain to the students that natural elements or compounds in the earth's crust are minerals. Tell students that minerals are identified by testing their properties.

3. Discuss the written Instructions for each of the stations with the students.

4. Assign the students to six different groups.

5. Assign groups to stations one through six.

6. Give each student the handout MINERAL IDENTIFICATION. Have students follow instructions at the station.

7. After the handout MINERAL IDENTIFICATION has been completed, conduct a class discussion about the results.

8. Ask the students why some minerals are in short supply. Discuss the importance of minerals and ways to conserve them.

HARDNESS SCALE
Chart

1. Talc
2. Gypsum
3. Calcite
5. Apatite
6. Orthoclase
7. Quartz
8. Topaz
9. Corundum
10. Diamond

HARDNESS TEST (Scratch Test)
Chart

1. Talc can be scratched with a fingernail.
2. Gypsum can be scratched with a fingernail.
3. Calcite can be easily scratched by a penny, but not with a fingernail.
4. Flourite can be scratched by a knife but not a penny.
5. Apatite can be barely scratched with a knife.
6. Orthoclase can scratch the knife blade but not vice versa.
7. Quartz can scratch a piece of glass.
8. Topaz can scratch quartz.
9. Corundum can scratch topaz.
10. Diamond can scratch almost anything.

MINERAL IDENTIFICATION
Handout

MINERAL	WEIGHT	COLOR/STREAK	SMOOTHNESS	HARDNESS	IDENTIFICATION
A.					
B .					
C.					
D.					
E.					

GRADE 5
EARTH SCIENCE

UNIT: Land and Its Resources
TOPIC: Conservation
OUTCOME: 51. Explain why topsoil must be preserved.

OUTCOME: 52. Discuss methods of conserving soil and water.

Background

Soil is mostly weathered rock. In some places, it is very deep. In other places, the layer is thin. The best soil has a layer of humus on top. Humus is a substance that results from the partial decay of plant and animal life. Humus helps to hold water in the soil. In this activity, the students will see how an organic material will help to keep soil together, preventing erosion. This activity will take seven class days to complete. The methods of conserving water are not addressed in this activity.

Materials

- Cylinder, graduated
- Newspaper

For each group:
- Soil, garden
- Tumblers, plastic
- Window screen, 1 section
- Butter tubs, plastic (2)
- Flour
- Jars (2)
- Water
- Pan, large

Procedures

Day One

1. Ask the students the following questions: Why do you think grass or other plants are usually seen along roadsides and on steep slopes leading from higher ground along highways? How do farmers prevent rich topsoil from washing away after they harvest their main crops? Why is it important to preserve topsoil.

2. Discuss the possible answers but tell students they will discover more answers later in the activity.

3. Assign students to small groups.

OUTCOMES 51 and 52 (Continued)

Procedures (Continued)

4. Distribute materials to each group, and direct each group to make identifying marks on the butter tubs.

5. Direct each group to sift a large tumbler of garden soil through the piece of window screen.

6. Direct each group to pour equal amounts of the soil into the two jars.

7. Have each group measure 15 milliliters of flour and pour it into one of the jars.

8. Direct each group to empty the soil from each jar into a butter tub. Have the students mark the tubs in some way to identify the soil containing the flour.

9. Ask the students to water the tubs of soil equally and place them in an area where they will not be disturbed.

Days Two through Six

1. Direct each group to water the soil in both tubs each day. Caution each group to use equal amounts of water for both tubs.

Day Seven

1. Direct students to cover their working area with newspaper.

2. Have each group put water in a large pan and place the pan on the newspaper.

3. Have students place the tubs of soil upside down on the newspaper and gently tap the bottom of each tub so that the soil samples drop out of the tubs onto the paper.

4. Direct each group to place the soil samples in the pan of water. Ask each group to time how long it takes for each soil sample to break apart. State that the breaking up of soil in water is called "slaking."

5. Lead a discussion, based on questions such as the following:

    a. Which soil sample broke apart faster? (The soil sample containing no flour)

b. Why do you think grass or other plants are usually seen along roadsides and on steep slopes leading down higher ground along highways? (The vegetation holds the soil together and prevents the soil from washing away.)

c. What would cause flour to keep soil from breaking up as fast as soil without the flour? (Flour is made from grain, an organic matter. An organic matter is derived from living organisms.)

d. What other organic materials might prevent soil from washing away? (Wheat, rye, barley, oats, sugar cane, bamboo)

e. How do farmers prevent rich topsoil from washing away after they harvest their main crops? (They plant a cover crop of grain. Topsoil is fertile because decaying humus provides good nutrients. When the topsoil washes away, the soil left cannot support the growth of crops. Farmers also plow the land carefully in certain patterns to help conserve the rich topsoil.)

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Components of the Solar System
OUTCOME: 53. Explain the components of the solar system: the sun, planets and their satellites, meteors, comets, and asteroids.

Background

This activity allows selected students to become familiar with one particular component of the solar system and to share their knowledge with others. The students need to have prior knowledge of the components of the solar system and need to be assigned one of the components for which they will gather information. Resources such as textbooks, encyclopedias, encyclopedias of astronomy, or library books about planets, meteors, comets, and asteroids are required. Resource materials may be gathered and made available for the students to use in the classroom. At the conclusion of their research, students will construct buttons that will announce their expertise on their topics and encourage others to ask them to share their information.

Direct students to glean facts that are not common knowledge; for example, the chemical make-up of a planet's atmosphere; the chemical components of the planet; the number of moons orbiting the planet; the number of rings around the planet; the length of time for the planet to orbit around the sun; specific names of different comets and meteorites, the size and impact dates of meteorites; periods and expected return dates of comets; and the names, sizes, and shapes of the moons orbiting seven planets in the solar system. This information can be found in most recently published textbooks which include a unit on astronomy. Ensure that encyclopedias and other reference materials are current since data collected in the 1980's by the Pioneer and Voyager spacecrafts have increased our knowledge significantly.

Since there are fourteen components listed in this activity, it will be necessary in most classrooms for more than one student to work on each component. The activity will require approximately one and one-half hours. The first hour will be devoted to class discussion and individual research. The construction of the buttons may take thirty minutes after the research is completed.

OUTCOME 53 (Continued)

Materials

- A variety of reference materials
- Pencils and papers
- Handout: BUTTON PATTERN
- Small piece of poster board, approximately 5" x 5"
- Markers, fine, felt-tip
- Safety pin, large
- Adhesive-backed plastic, clear, approximately 5x5 inches
- Tape
- Scissors

Procedures

1. Make a sample button following the directions given later in the procedures. Write "Ask Me About the Solar System" on the sample button and wear the button during this activity.

2. Conduct a discussion reviewing the components of the solar system. List the following components on the chalkboard: Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, Satellites, Meteors, Comets, and Asteroids.

3. Assign one component of the solar system to each student. Explain that they will use the reference materials provided in the classroom to do research about a chosen component, and that they will be expected to become experts on a particular topic. Explain that upon completion of their research, they will construct a button to be worn around the school, at home, or any place of their choosing. State that wearing the button will encourage others to ask them for information about their topics of expertise.

4. Instruct students to search for unique facts about their assigned components, such as the ones listed in the background information of this activity. List these ideas on the chalkboard to be used as references. Have students record appropriate facts on paper.

5. Allow approximately forty-five minutes for research and study of the facts collected. Allot extra time if needed. Assist students with research when necessary.

6. Instruct students to conclude the research activity and replace all reference materials.

7. Distribute materials needed for the construction of buttons.

8. Instruct students to cut out the pattern for their buttons.

OUTCOME 53 (Continued)
Procedures (Continued)

9. Have students trace the pattern onto the poster board and cut out their buttons.

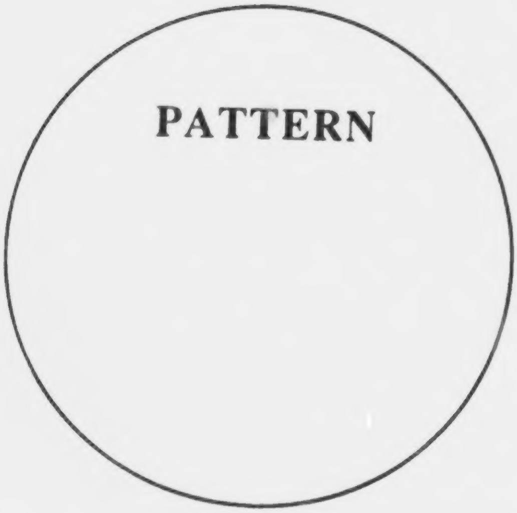
10. Instruct them to write "Ask Me About......," inserting the name of their components on the front of their buttons, using colored, felt-tip markers. Explain that they may decorate their buttons, including a picture of their components or some other design of their choosing.

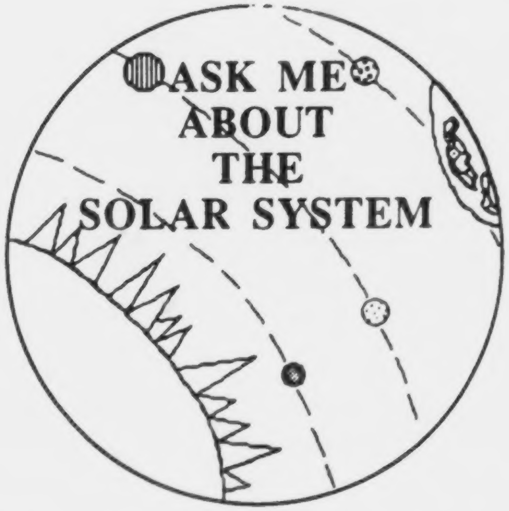
11. Have students cover the front of their buttons with the clear adhesive-backed plastic and tape a safety pin on the back, centered near the top (as shown in the illustration).

12. Have them place their buttons on their clothing and instruct them to wear them throughout the day (or perhaps for several days), encouraging others to ask them to share their expert knowledge. Have students circulate around the classroom, practicing their abilities to share their expertise with other members of the class. Circulate among the students, comment on the buttons, and ask for information.

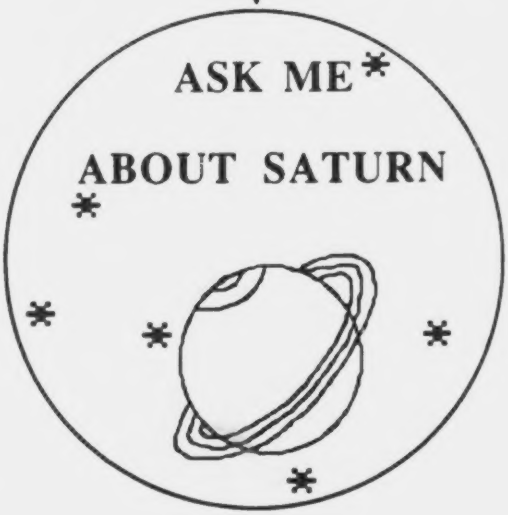
13. On the following day, ask students to tell about the occasions when they were able to share their expertise. Encourage them to wear their buttons again and try for additional opportunities to share information.

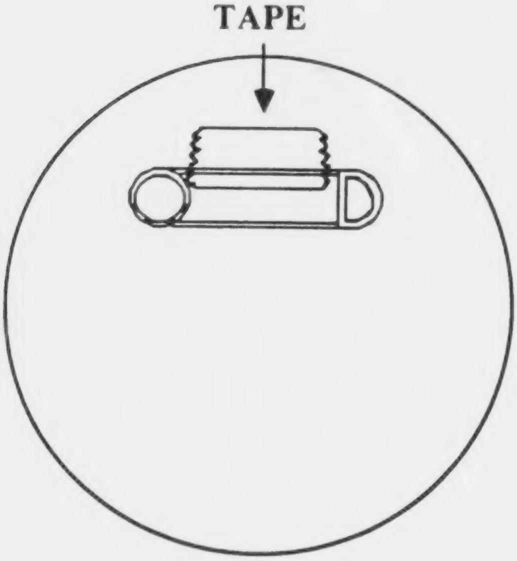
BUTTON PATTERN
Handout




ASK ME
ABOUT
THE
SOLAR SYSTEM

SAMPLE FRONT OF BUTTON


ASK ME
ABOUT SATURN



BACK OF BUTTON

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Components of the Solar System
OUTCOME: 54. Explain that the sun is the center of the solar system and the planets revolve and rotate in orbit around it.

Background

This activity allows students to illustrate the approximate distance between planets and the sun by making a scale model of the solar system. Students need to understand the meaning of a scale model and must realize that the distances in this activity are approximately scaled. Students also need to be reminded that the distances for Neptune and Pluto are based on their orbital positions when Pluto is the outermost planet. At present Pluto is orbiting inside the orbit of Neptune and will continue to do so until the year 1999.

This activity will require at least one hour to complete.

Materials

- Poster board, yellow
- Poster board, white (9)
- String, approximately 275 yards or 269 meters
- Tubes, fish line rolls, or paper towel rolls
- Paper punch

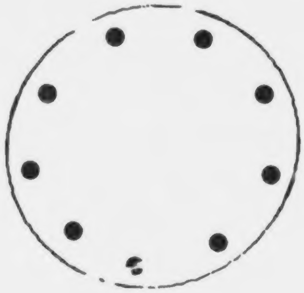
For each group:
- Scissors
- Crayons
- Markers
- Yard stick or meter stick

Procedures

1. Cut a circle as large as possible from the yellow poster board to represent the sun.

OUTCOME 54 (Continued)
Procedures (Continued)

2. Punch nine evenly spaced holes around the edge of the sun.



3. Explain to students that this activity will allow them to place themselves in orbit around the sun as if they were planets in the solar system. Explain that they will create a scale model of the orbits of the planets and their distances from the sun.

4. Divide the class into nine small groups.

5. Give each group a piece of white poster board, and direct groups to cut a six- to eight-inch circle to represent a planet. Remind groups that the sizes of the planets will not be to scale.

6. Instruct groups to label and color their planets.

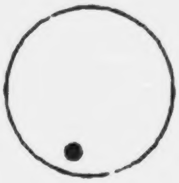
7. Copy the following chart on the chalkboard while groups are preparing their planets.

PLANET	DISTANCE FROM SUN
Mercury	36 inches (90 cm)
Venus	67 inches (170 cm)
Earth	93 inches (2.36 m)
Mars	141 inches (3.58 m)
Jupiter	13.5 yards (12 m)
Saturn	25 yards (23 m)
Uranus	50 yards (46 m)
Neptune	78 yards (71 m)
Pluto	100 yards (92 m)

OUTCOME 54 (Continued)

Procedures (Continued)

8. When all groups have completed the planets, direct members of each group to punch a hole near the edge of their planet. Have each group measure and cut a length of string by using the distances provided on the chart. Instruct them to wind the string carefully around a tube or roll, making sure that it does not tangle. (Give assistance to groups working on outer planets.)



9. Explain to the students that they will go outside to the playground and form a model of the solar system. Show them the sun which will be in the center, and explain that they will attach one end of their strings to the sun when they get outside.
10. Lead the class to the playground, and assist them in attaching their strings to the sun.
11. Direct members of each group to measure (by walking) the approximate distance of their planet from the sun by unraveling the string. Instruct them to attach the other end of their string to their planet when they have reached the full distance.
12. Have groups stand closely around their planet and slowly revolve around the sun. Then have students take turns rotating their bodies around as they move in orbit around the sun.

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Components of the Solar System
OUTCOME: 55. Explain the difference between refracting and reflecting telescopes.

Background

This activity consists of two parts, the first being a brief research assignment in which students define refracting and reflecting telescopes. The second part of the activity offers optional demonstrations which can be adapted for use when appropriate.

Part A, the research assignment, will require thirty to forty-five minutes. Additional time must be alloted for optional activities.

Materials

Part A

For each student:
- Textbooks and/or encyclopedias
- Other appropriate reference materials
- Pencil
- Paper

Part B

For each student:
- Hand lens
- Pan, shallow
- Coin
- Pitcher of water
- Lenses, convex (2), one larger than the other
- Cardboard, corrugated
- Tape
- Table tennis ball
- Mirrors, hand (2)
- Aluminum foil, small section

Procedures

Part A

1. Ask students to name some ways that astronomers study

OUTCOME 55 (Continued)
Procedures (Continued)

the universe. (Observation of the sky, use of the telescope, use of information obtained from satellites) Explain that telescopes have been a useful tool since the early 1600s.

2. Ask students to name two types of telescopes. (Refracting and reflecting)

3. Instruct students to look for information in textbooks, encyclopedias, and other available reference materials that will explain the difference between refracting and reflecting telescopes. Ask students to write descriptions of each type of telescope on their papers.

4. Allow time for students to complete the research. Conduct a discussion of their findings as an evaluation of their work. Emphasize to the students the major differences between refracting and reflecting telescopes. (The lenses bend or refract light to form an image with a refracting telescope. The reflecting telescope relies upon a concave mirror rather than a lens to form an image. Light enters this telescope and reflects from the concave mirror onto a small flat mirror, which in turns reflects the light to the outside of the tube into the eyepiece. Images in refracting telescopes are magnified many times, depending on the strength or power of the lenses. Images in reflecting telescopes are magnified many times, depending on the length of the tubes and curvature of the mirrors and lenses.

Part B

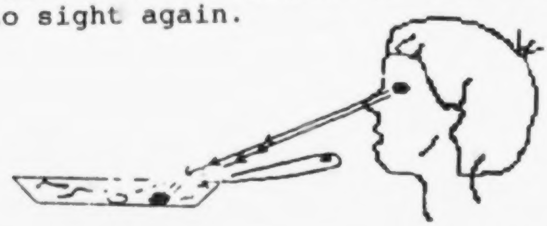
Allow small groups to complete one or more of the following activities, or select one or more activities to use as a demonstration of the concepts students have researched.

REFRACTING TELESCOPE

1. Demonstrate how a convex lens brings light to a focus by holding a hand lens outdoors so that sunlight shines through it onto a sidewalk. Move the lens back and forth until you see a sharp, bright spot on the sidewalk. Note that the bright spot is the sun's image created when light strikes the convex lens and is bent in such a way that it is brought to a focus.

Procedures (Continued)

2. Demonstrate refraction of light by placing a coin in a shallow pan. Have a student stand at a position so that the coin just barely disappears from sight. Add water to the pan. Ask the student to tell when the coin comes into sight again.



(This happens because light rays bend downward when they travel through air and into water. The diagram explains this demonstration.)

3. Build a simple refracting telescope with two convex lenses, one larger than the other. Roll a piece of corrugated paper into a tube to fit around the larger (objective) lens. Fasten the edges of the tube with tape. Make another tube about the same length to fit the smaller (eyepiece) lens. Position this tube inside the first tube and adjust to fit if necessary. Fasten the eyepiece lens inside the second tube. Slide one tube inside the other and focus on an object such as a brick wall or leaves on a nearby tree.

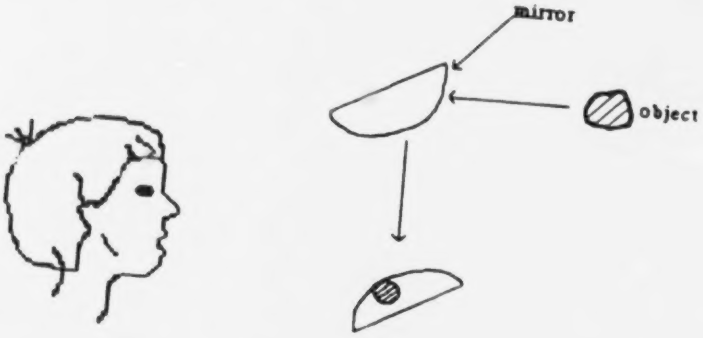
REFLECTING TELESCOPE

1. Demonstrate a representation of light reflected at an angle by bouncing a table tennis ball. Have students observe the angle of the rebound. Relate their observations to light reflecting at an angle from a smooth surface.

2. Demonstrate that smooth surfaces reflect light regularly while irregular surfaces reflect light in all directions. Give each student a small piece of aluminum foil and have students observe their image made when light reflects from the smooth surface. Have students crumple the foil and observe that the clear image is no longer visible.

OUTCOME 55 (Continued)
Procedures (Continued)

3. Demonstrate the reflection of light by using two mirrors placed at an angle so that the image is reflected from one onto another. Discuss the fact that most light travels in a straight line.



GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Components of the Solar System
OUTCOME: 56. Calculate the distance between the moon and the earth.

Background

The distance between the earth and the moon varies from month to month. This change is due to the fact that the moon's orbit around the earth is elliptical. The average distance between the earth and the moon is 232,043 miles. This activity helps students relate the distance from the earth to the moon in hours and days in comparison to the speed of various modes of transportation.

The activity described may be conducted by individual students or by small groups of students.

Materials

For each student:
- Handout: EARTH TO MOON CALCULATIONS

Procedures

1. Introduce the lesson by asking questions such as:
    - What is the distance from Earth to the moon?
    - How long would it take you to drive to the moon in hours and in days?
    - If traveling on a supersonic jet, what would be the travel time to the moon in hours and in days?
2. Record students' answers on the chalkboard.
3. Explain to students that the approximate distance from Earth to the moon is 232,043 miles.
4. Give each student a copy of the handout EARTH TO MOON CALCULATIONS. Ask students to compute the amount of time needed to reach the moon if traveling by car, jumbo jet, or supersonic jet.
5. Follow the activity with a discussion of the questions and responses on the handout EARTH TO MOON CALCULATIONS. Compare discussion responses with those recorded on the board.

OUTCOME 56 (Continued)

Extensions

1. Research and write about attempts to travel to the moon.
2. Research and write a story about the first landing on the moon.
3. Make a diorama of the first landing on the moon.

EARTH TO MOON CALCULATIONS
Handout

The average distance from Earth to the moon is 232,043 miles. Compute the time needed to reach the moon when traveling various modes of transportation.

1. The approximate distance from New York to California is 3,093 miles. A trip from Earth to the moon would be equivalent to how many trips from New York to California?

2. The speed limit on most interstate highways in the United States is 65 miles per hour. Traveling the speed of 65 miles per hour, how long will it take the family car to reach the moon in hours and in days?

3. A Boeing 747 jumbo jet cruises at a speed of 600 miles per hour. How long will it take a Boeing 747 to reach the moon in hours and in days?

4. An airplane flies at 761 miles per hour or Mach 1. The SST Concorde flies at a cruising speed of 1400 miles per hour or Mach 2.2. Calculate the flying time required the SST Concorde to reach the moon in hours and in days.

EARTH TO MOON CALCULATIONS
Key

The average distance from Earth to the moon is 232,043 miles. Compute the time needed to reach the moon when traveling various modes of transportation.

1. The approximate distance from New York to California is 3,093 miles. A trip from Earth to the moon would be equivalent to how many trips from New York to California?

75 trips to
3,093 miles $\overline{)232{,}043}$ miles to the moon
from New
York to
California

2. The speed limit on interstate highways in the United States is 65 miles per hour. Traveling the speed of 65 miles per hour, how long will it take the family car to reach the moon in hours and in days?

3570 hours
65mph $\overline{)232{,}043}$ miles to the moon

148 days to the moon
24 hours $\overline{)3570}$ hours to the moon
in a day

3. A Boeing 747 jumbo jet cruises at a speed of 600 miles per hour. How long will it take a Boeing 747 to reach the moon in hours and in days?

387 hours to the moon
600 mph $\overline{)232{,}043}$ miles to the moon

16 days to the moon
24 hours $\overline{)387}$ hours to the moon
in a day

4. An airplane travels at 761 miles per hour Mach 1 . The SST Concorde flies at a cruising speed of 1400 miles per hour or Mach 2.2. Calculate the flying time required for the SST Concorde to reach the moon in hours and in days.

166 hours to the moon
1400 mph $\overline{)232{,}043}$ miles to the moon

7 days to the moon
24 hours $\overline{)166}$ hours to the moon
in a day

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Components of the Solar System
OUTCOME: 57. Discuss light years as units of measure for distances between objects in the solar system and beyond.

Background

Metric measurements are used in labeling distances in this activity. Kilometers may be converted to miles by multiplying by 0.6.

A light-year is the distance light travels in one year at a speed of 300,000 km/sec. It is equal to about 9.5 trillion kilometers. Astronomers calculated the distance measurement called a light-year to help them study great distances in space. In order to create this measurement, they first found the number of seconds in one year. Then they multiplied this number by 300,000 kilometers. A light-year is a unit of distance, not time.

This activity will require approximately forty-three minutes.

Materials

- Meter sticks (4)
- Textbooks and other references

For each student:
- Paper and pencil

OUTCOME 57 (Continued)

Procedures

1. Explain that astronomers must use large distances when they are studying other objects in the solar system.
2. Explain that using small units of measure to calculate large distances can be difficult to manage due to the very large numbers involved.
3. Divide the class into four groups. Give each group a meter stick and assign one group to measure each wall of the classroom. Instruct each group to measure the wall in millimeters and then in meters.
4. Have each group report their measurements and record them on the chalkboard. Ask a student to add all distances, using both units of measure. Discuss the differences between computing distances using millimeters and distances using meters. Emphasize that it is easier to manage the calculations using the larger unit (numbers are smaller).
5. Point out that using millimeters to measure a classroom is similar to using kilometers to measure distances in space. Explain that early astronomers faced the problem of numbers being too large to work with when they were studying distances in space, so they designed a much larger unit of measure called the light-year. Explain that just as a meter may be more appropriate than a millimeter for measuring a classroom, a light-year is a more appropriate measuring unit than a kilometer for measuring the large distances in space.
6. Ask for a student volunteer to define the term light-year. Explain the term further if necessary.
7. Make a list of stars on the chalkboard. Include the following stars: Proximar Centauri, Sirus, Vega, and Rigel. List additional stars if desired.
8. Review the list of stars with the students. Explain that Proxima Centauri is the closest star to Earth, but that it is still over 40 trillion kilometers away. Write the number 40,000,000,000,000 on the chalkboard for students to see.

OUTCOME 57 (Continued)
Procedures (Continued)

9. Compute the number of light years equivalent to 40,000,000,000,000 with the class.

$$9.5\overline{)40{,}000{,}000}$$

(Use calculators if they are available).

10. Instruct students to use their textbooks and other reference materials to find the distance to each star on the list in terms of light-years. Ask them to record their findings. Assist students in finding information if needed.

11. Conduct a discussion allowing students to report their findings.

GRADE 5
EARTH SCIENCE

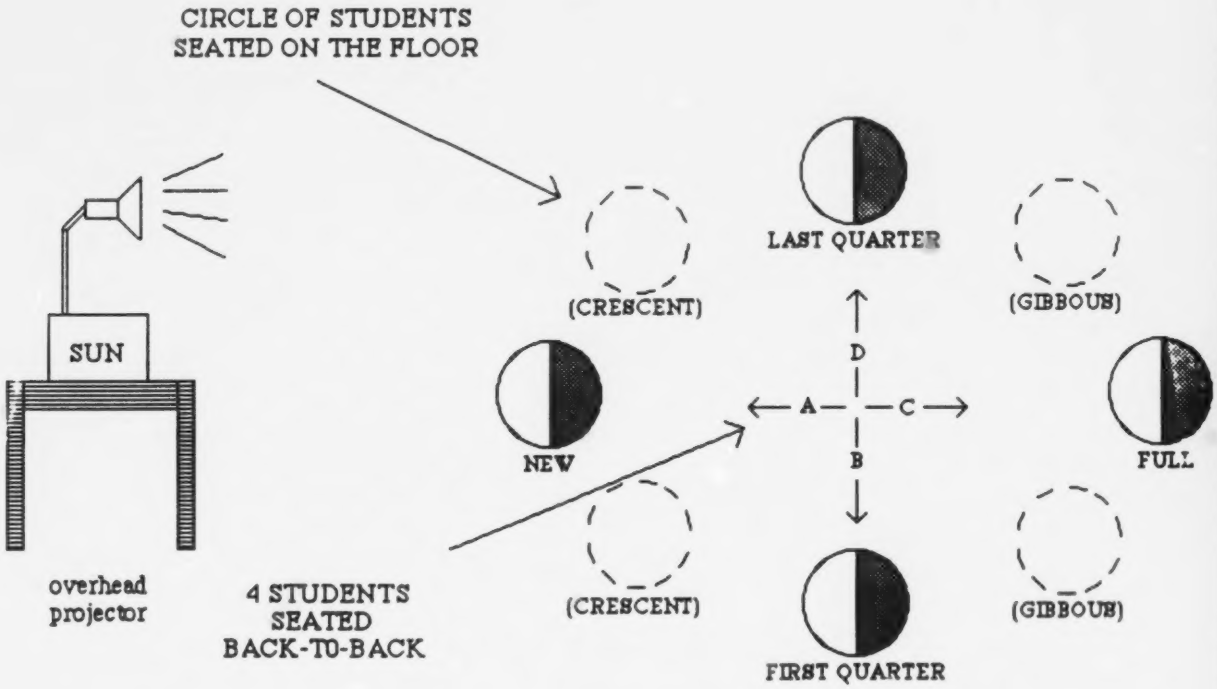
UNIT: Space
TOPIC: Relationships Between the Moon and the Tide
OUTCOME: 58. Describe the phases of the moon.

Background

In this activity students will participate in making a model that demonstrates the revolution of the moon and its phases. Each student will be actively involved in making the model by playing a role either as a part of the moon's revolution around the earth, or as the earth from the center of its orbit.

This activity, which should be preceded by a study of the phases of the moon, will require about half an hour. Describe the names of the phases: new moon, crescent, first quarter, gibbous, last quarter, and full. Ask students to identify and describe each phase as it appears in the model. Since the crescent and gibbous moons are actually extensions of one of the four quarters of the moon, they may be omitted from this activity if they have not been included in the unit. For the best possible results, use a light-colored ball and a completely dark room. Note that the effectiveness of this activity is lessened in a partially darkened room.

The following diagram shows the position of the students in the model. Following the diagram is an explanation of each phase as it will be observed from the center of the circle.


CIRCLE OF STUDENTS SEATED ON THE FLOOR
SUN
overhead projector
4 STUDENTS SEATED BACK-TO-BACK
(CRESCENT)
LAST QUARTER
(GIBBOUS)
NEW
A
D
C
B
FULL
(CRESCENT)
FIRST QUARTER
(GIBBOUS)

OUTCOME 58 (Continued)
Background (Continued)

The revolution of the moon begins with the student nearest the sun and continues counterclockwise around the outer circle. The student in position "A" will first observe the new moon and then the crescent moon. The student in position "B" will observe the moon in its first quarter and the gibbous moon. The student in position "C" will observe the full moon and another gibbous moon. The student in position "D" will observe the moon in its last quarter and a crescent moon.

Materials

- Overhead projector
- Round ball, large
- Tape, masking

Procedures

1. Use the masking tape to mark an "X" on the ball to represent the side of the moon that is always facing the earth.

2. Place the overhead projector on a table near an open area in the room. Turn on the projector so that the light is directed toward the open area.

3. Have students sit on the floor in a circle in the open area. Direct students to make a closed circle with each student facing the center of the circle. These students will represent the revolution of the moon.

4. Select four students to represent the earth. Have them sit in the center of the inner circle with their backs together as shown in the illustration in the background material.

5. Explain to the students that the overhead projector represents the sun, the students in the center of the circle represent the earth, the ball represents the orbital path of the moon around the earth. Explain that the "X" on the ball represents the side of the moon that always faces the earth, because as the moon circles the earth, it also turns on its axis, keeping the same face toward the earth.

6. Explain that the students in the outer circle will hold the ball above their heads and pass it around the circle to create the moon's orbit. Instruct them to keep the "X" face of the moon facing toward the center and to keep the position of the ball high enough so that it is in the path of the light from the sun.

OUTCOME 58 (Continued)
Procedures (Continued)

7. Explain that the four students in the center will observe the moon as it travels around, describing the phase of the moon that they see from their particular position.

8. Give the ball to a student in the outer circle nearest the overhead projector. Darken the room and have students begin passing the moon slowly around the circle.

9. Have students stop the ball at appropriate intervals and allow each student seated in the center to describe exactly what is seen. Ask them to name the phase that they have described.

10. Alternate students in the center after each rotation until each student in the class has had an opportunity to represent the earth and describe a phase of the moon. Caution students not to look directly into the overhead projector light.

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Relationships Between the Moon and the Tide
OUTCOME: 59. Explain how the phases of the moon and the tides are related.

Background

Tides are caused by a gravitational pull on the earth and its waters exerted by the moon and the sun. The moon's pull is greater than that of the sun because the moon is much nearer to the earth. The moon's gravity pulls the water nearest the moon slightly away from the earth. At the same time, the moon pulls the earth slightly away from the water on the opposite side of the earth. In this way, the moon's gravity produces two bulges on the ocean. These bulges are the positions of high tide. Low tide areas form as a result of the outward flow of waters to high tide locations.

The sun's gravitational pull also affects the tides, but the sun's great distance from the earth reduces its pull on the earth's waters. The sun's tide-making force can increase or decrease that of the moon. When the sun's gravitational pull is added to that of the moon's, high tides are at their highest and low tides at their lowest. These tides, which occur twice a month, are called spring tides. When the sun opposes the moon, at the moon's first and last quarters, the lowest high tides and the highest low tides occur. These tides, also occurring twice a month, are called neap tides.

Only four of the moon's eight phases are mentioned in this activity. The crescent and the gibbous moons are not included since they do not significantly affect the high and the low tides.

This activity will allow students to demonstrate what they have learned about the spring tides and neap tides by creating a model to illustrate each. The activity requires approximately a one-hour class period. Students will work in small groups. Patterns for the model are included.

Materials

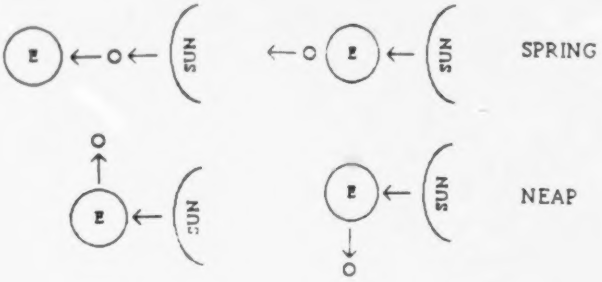
For each group:
- Poster board, white (1 sheet)
- Plate, paper, 9 1/2 inch

For each student:
- Scissors
- Crayon or markers
- Handout: PATTERNS FOR MOON PHASES
- Handout: UNDERSTANDING THE TIDES

OUTCOME 59 (Continued)

Procedures

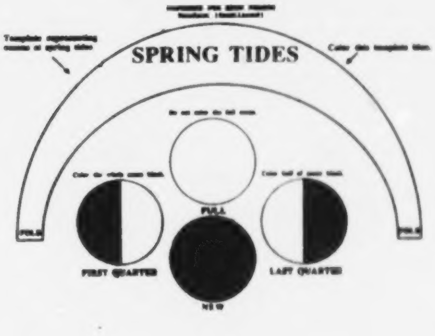
1. Discuss how the phases of the moon and the tides are related. Explain how spring tides and neap tides are formed.
2. Draw the following diagrams on the chalkboard.

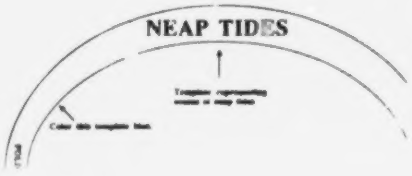


3. Explain that students will be working in small groups to create a model illustrating how the moon's phases affect the tides.
4. Divide the class into small groups. Instruct each student to bring his or her scissors and crayons or markers to the group.
5. Distribute a sheet of poster board, one copy of the handout PATTERNS FOR MOON PHASES, and a paper plate to each group. Give each student a copy of the two-page handout UNDERSTANDING THE TIDES.
6. Instruct the groups to fold their poster boards in half length-wise, matching corners and edges carefully. (See illustration.)

OUTCOME 59 (Continued)
Procedures (Continued)

7. Have groups cut out patterns for moon phases, and trace them onto the poster board, being careful to place marked "fold" lines on the fold of the poster board.





8. Have students label and color each cut-out according to the directions on the patterns.

9. Explain to the students that the paper plate represents the earth. Have the groups label and color each paper plate.

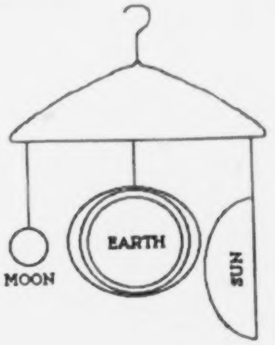
10. Instruct groups to assemble the model by placing the paper plate near the center of a table or desk to represent the earth. Position the sun and the moon either in straight lines with the earth, or at right angles with the earth, using the appropriate pattern to show either a spring tide or a neap tide.

11. Have students refer to the handout PATTERNS FOR MOON PHASES at this time for further directions on how to position their models.

12. Instruct students to complete the handout UNDERSTANDING THE TIDES as they complete the model.

13. Discuss the answers students have provided on the handout UNDERSTANDING THE TIDES.

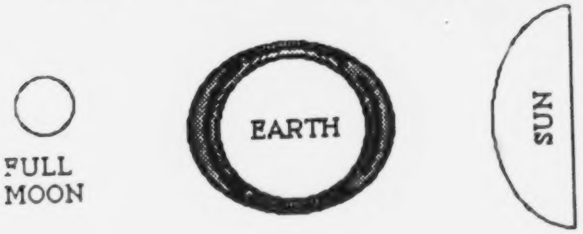
14. Select some of the better models to display on a bulletin board or in an interest center. Have each group suspend its model from a coat hanger to form a mobile.

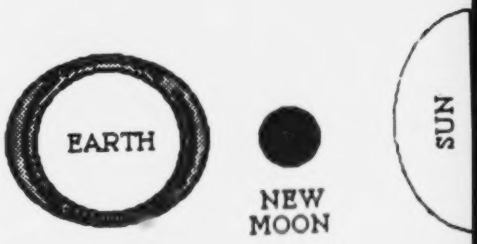


UNDERSTANDING THE TIDES
Handout

When the sun and moon are in line with the earth, spring tides are formed. The sun and the moon are in line with the earth during the full-moon phase and the new-moon phase; therefore, spring tides come approximately every two weeks.

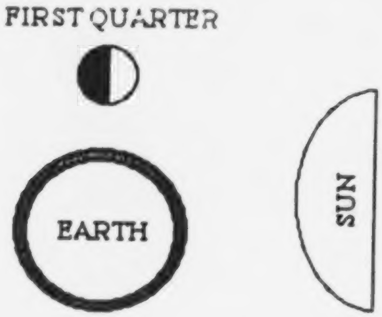
Use your model to create two different illustrations of spring tides. The diagrams below will help you.

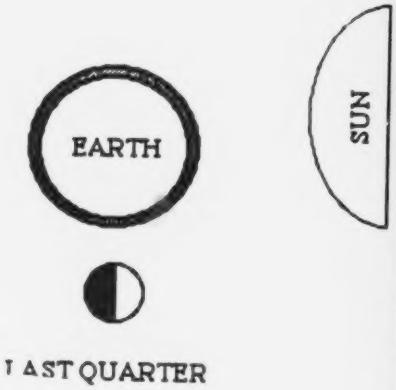

FULL MOON
EARTH
SUN


EARTH
NEW MOON
SUN

When the sun and moon are pulling on the earth at right angles, neap tides are formed. The sun and the moon are at right angles with the earth in the moon's first quarter and again in its last quarter.

Use your model to create two different illustrations of neap tides. The diagrams below will help you.

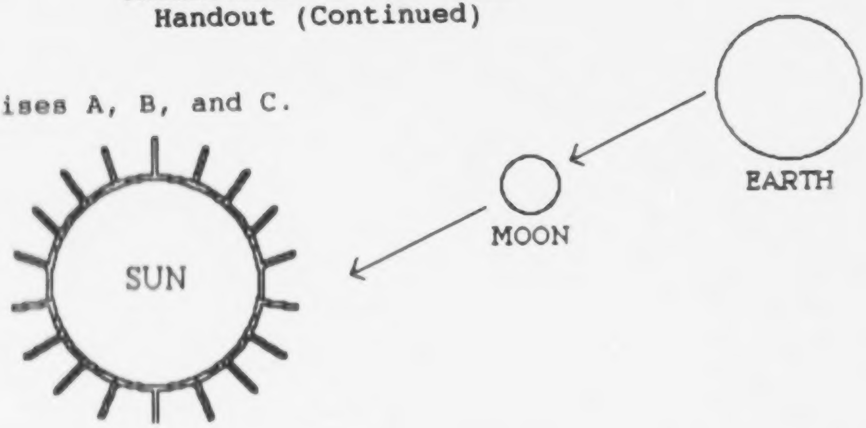

FIRST QUARTER
EARTH
SUN


EARTH
SUN
LAST QUARTER

UNDERSTANDING THE TIDES
Handout (Continued)

Complete exercises A, B, and C.

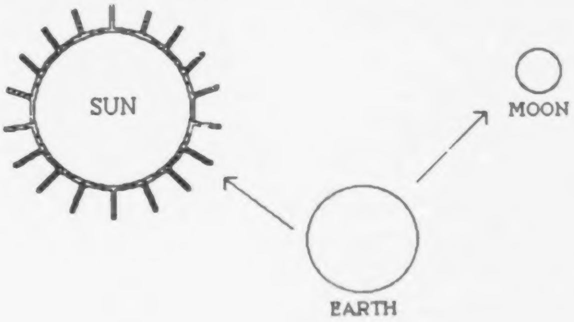
A


SUN
MOON
EARTH

Does this diagram show a neap or spring tide? ____________________

How do you know? ____

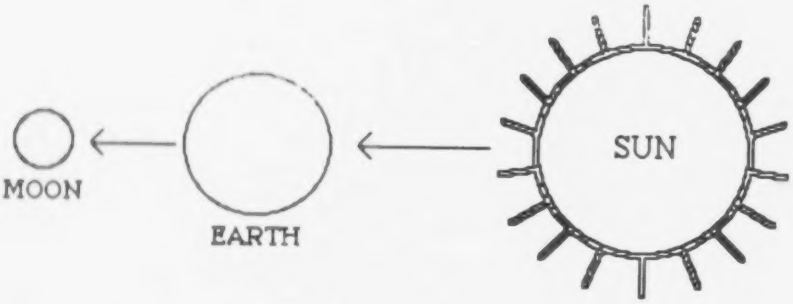
B


SUN
MOON
EARTH

Does this diagram show a neap or spring tide? ____________________

How do you know? ____

C


MOON
EARTH
SUN

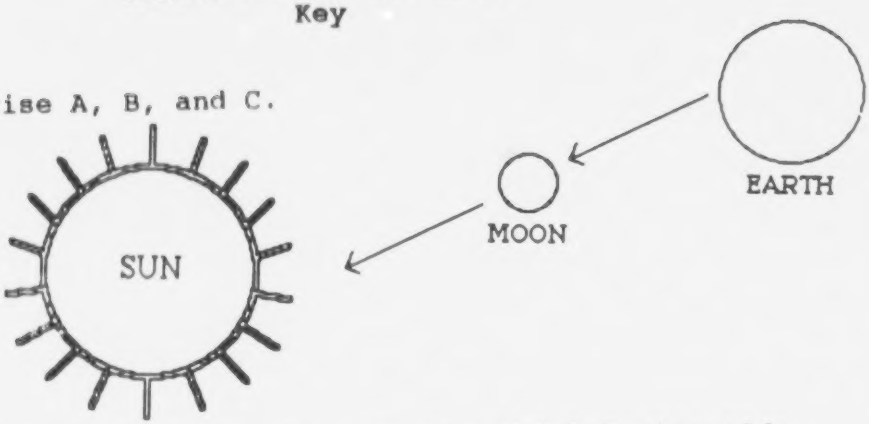
Does this diagram show a neap or spring tide? ____________________

How do you know? ____

UNDERSTANDING THE TIDES
Key

Complete exercise A, B, and C.

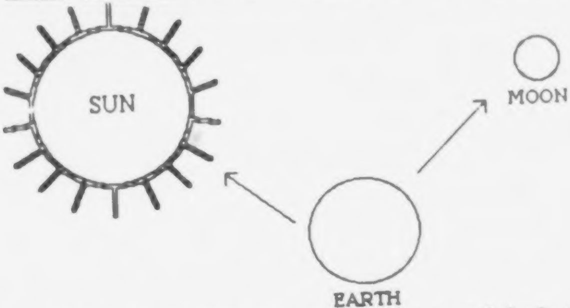
A



Does this diagram show a neap or a spring tide? Spring tide

How do you know? The sun and moon are in line with the earth.

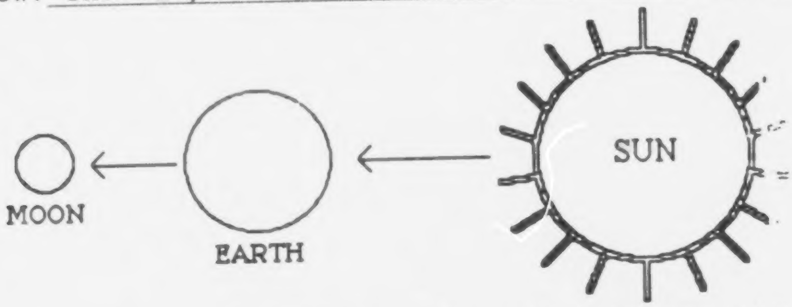
B



Does this diagram show a neap or a spring tide? Neap tide

How do you know? The sun, moon, and earth form right angles.

C



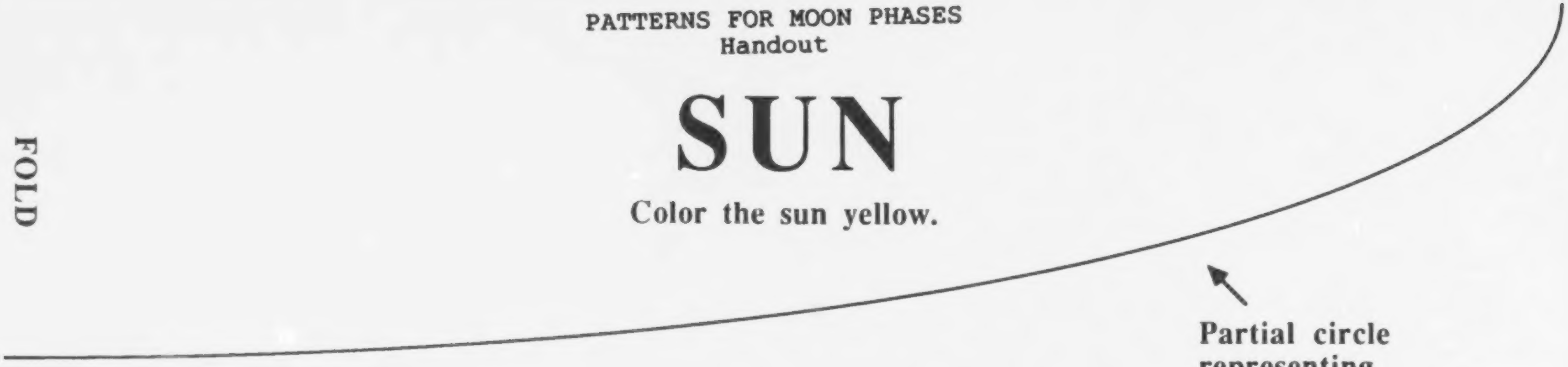
Does this diagram show a neap or a spring tide? Spring tide

How do you know? The sun and moon are in line with the earth.

PATTERNS FOR MOON PHASES
Handout

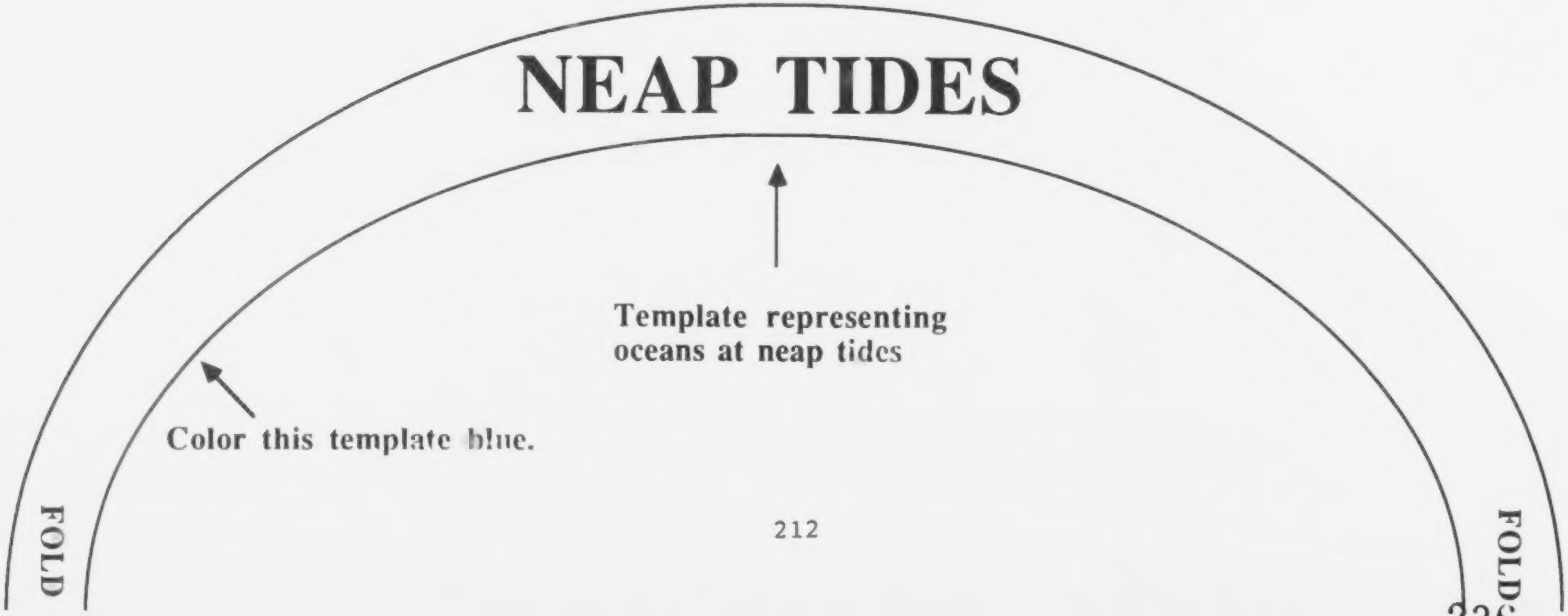
SUN

Color the sun yellow.



Partial circle representing the sun

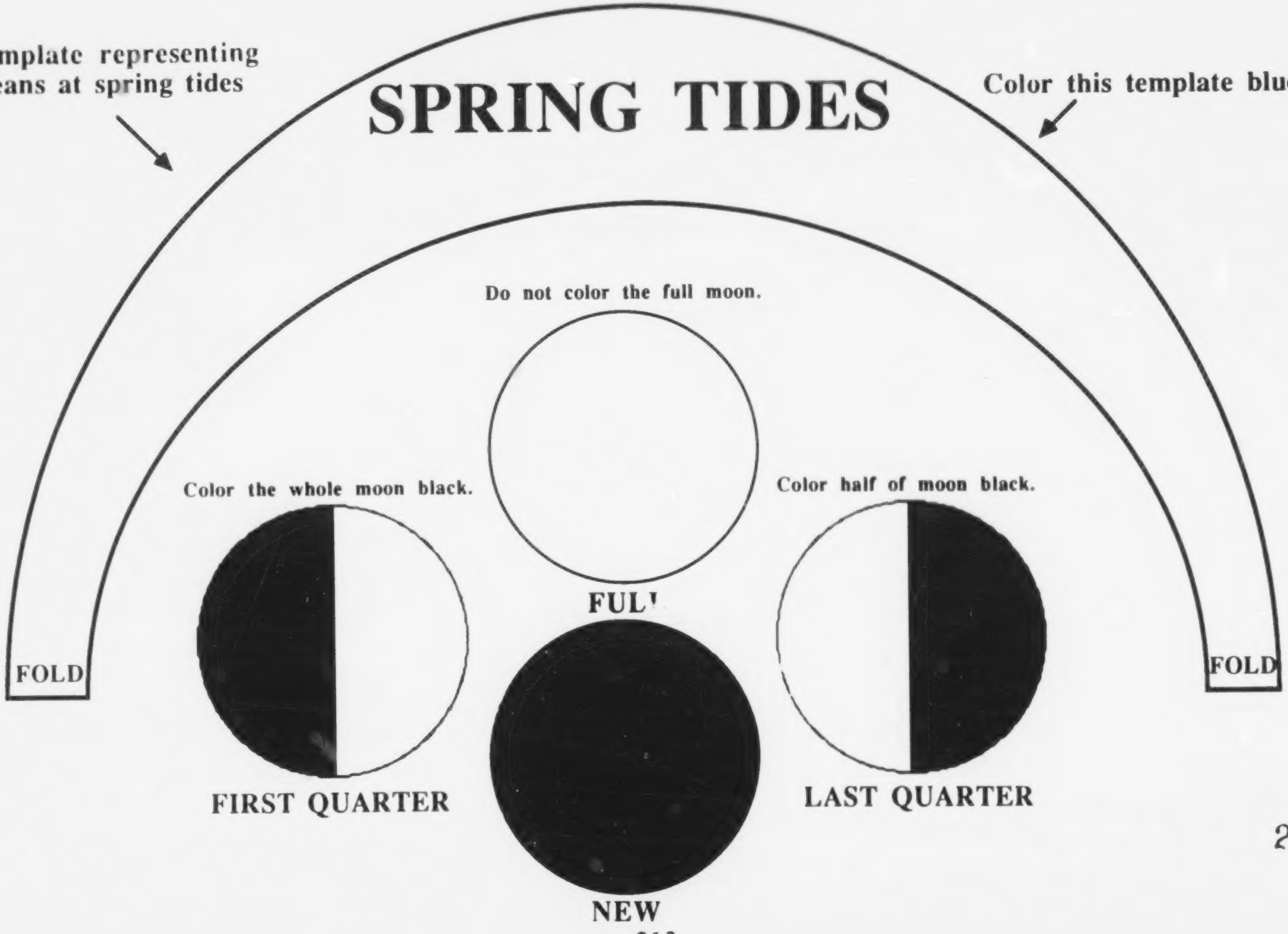
NEAP TIDES



Template representing oceans at neap tides

Color this template blue.

PATTERNS FOR MOON PHASES
Handout (Continued)



Template representing oceans at spring tides

Color this template blue.

Do not color the full moon.

Color the whole moon black.

Color half of moon black.

SPRING TIDES
FOLD
FOLD
FULL
FIRST QUARTER
LAST QUARTER
NEW

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Relationships Between the Moon and the Tide
OUTCOME: 60. Explain how the surface of the moon has been shaped by volcanic activity, gravity, and meteors.

Background

During the early years of the moon's formation, its surface was a sea of liquid rock hundreds of kilometers deep. Over a period of millions of years, the liquid rock, or lava, cooled and formed a crust. Huge rocks fell on the solid surface, blasting open gigantic craters. Billions of years later, the inside of the moon, the mantle, began building heat because the deeper part of the moon contained radioactive elements such as uranium. The heat of radioactivity built inside the moon for millions of years. Rocks melted and more lava collected in the mantle. In time, some lava worked its way up through the crust and spilled across the surface of the moon. As it cooled and solidified, it formed great plains of rock. Gigantic eruptions of lava continued to occur repeatedly over a period of nearly one billion years. Then, about three billion years ago, the lava flow ceased. The lava cooled slowly and formed the basins on the surface of the moon called "maria," or "seas."

The moon has had no volcanic activity for the past three billion years. It has changed little except for the continuing impact of meteors, asteroids, and comets, which have created craters of all sizes.

In this activity, students will work in groups to create models of the surface of the moon. They will form a representation of the moon's surface by making impacts in damp plaster of Paris with objects representing meteors. The plaster of Paris will be soupy for about fifteen minutes before it is dry enough to make an impression of the objects on the surface. The activity will require thirty to forty-five minutes.

Materials

- Model and/or map of the moon

For each group:
- Pie plate, aluminum
- Plaster of Paris (approximately four cups)
- Spoon, plastic

OUTCOME 60 (Continued)
Materials (Continued)

- Paper cup, small
- Several marbles, golf balls, and pebbles of various shapes and sizes
- Water

Procedures

1. Conduct a discussion of how the moon was formed. Include an explanation of lava flows, volcanic activity, and craters caused by meteors, known asteroids, and comets. Stress that there has been no volcanic activity on the moon in the past three billion years, but that changes still occur on the surface of the moon by impacts of other objects.

2. Refer to the model or map of the moon during the discussion and have students locate craters and marias on the surface of the moon.

3. Explain that students will work in groups to make models representing the moon's surface. Tell students that the pie plate will represent the moon's surface, and the marbles, golf balls, and pebbles will represent the impacting objects such as comets, asteroids, and meteors.

4. Divide the class into four groups.

5. Distribute the following to each group:
   - a marble
   - a golf ball
   - various sizes of pebbles
   - an aluminum pie plate
   - a small paper cup
   - a plastic spoon
   - water
   - Plaster of Paris

6. Explain that each group will measure two parts plaster of Paris and one part water into their pie plates and stir to mix. Direct groups to stir until all powder is dissolved and then place the plate on a shelf or a table so that it may begin to harden.

7. After about ten or fifteen minutes, when the plaster is no longer soupy, instruct groups to place objects in the plaster and remove them carefully to leave the imprint. Point out that a meteor that strikes the moon, a planet, or another celestial body is called a meteorite.

8. Ask selected students to describe the surface of their "moon."

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Exploration
OUTCOME: 61. Discuss problems associated with acceleration, weightlessness, radiation, deceleration, and distance in space travel.

Background

The problems that astronauts may encounter when traveling into space require them to carry protective gear and simulated Earth environment with them in order to survive. Once man leaves the natural habitat on Earth, he or she must overcome environmental conditions such as the following:

Zero gravity (weightlessness)
Acceleration/deceleration forces (high G-forces)
Radiation (gamma rays, cosmic rays, and ultraviolet rays)

ZERO GRAVITY

Weightlessness is very difficult to simulate on Earth. There is no such thing as a zero gravity machine. Engineers can simulate weightlessness by training space travelers in a neutral buoyancy tank. This is a large tank filled with water. The space trainee wears a specially designed suit with air pockets built into it so that he or she does not sink to the bottom of the tank or float. This means the person is merely suspended in the water as he or she would be in space.

ACCELERATION/DECELERATION FORCES

Acceleration is the change in speed or direction of a body divided by the time during which the change takes place. Newton's First Law of Physics states that a body at rest tends to stay at rest; therefore, everything tries to resist acceleration thus causing G-forces. (Deceleration is the opposite of acceleration: the slowing down of a body causes similar G-forces except in the opposite direction.)

OUTCOME 61 (Continued)
Background (Continued)

ACCELERATION/DECELERATION FORCES (Continued)

G-force stands for gravity force. A person experiences one G when standing still. When an automobile starts quickly after having stopped at a traffic light, the body is forced against the back of the seat. This is an additional G-force that is the result of rapid acceleration. When a space traveler is launched into space, the powerful rocket used to propel the vehicle upward induces several Gs of force on the crew as well as the structures of the rockets and the spaceship. Man can typically withstand three to four Gs (three to four times the normal force of gravity) for short durations. If an astronaut weighs 175 pounds normally, four Gs will make him or her weigh four times 175 pounds or 700 pounds. This places an enormous load on a human heart that was only accustomed to pumping blood for a 175-pound man. Because of this, engineers must design rockets that will not accelerate the spaceship too rapidly, or the people aboard will not survive.

RADIATION

Man is normally protected from the radiation of gamma, cosmic, and ultraviolet rays of the sun by the ozone layer above the earth and the dust and humidity (water) found in our atmosphere. When man leaves the atmosphere, protection is lost; therefore, radiation protection must be provided artificially by means of specially designed spacecraft, clothing, and eye glasses.

This activity gives students a better understanding of the environmental condition that must be met for survival in outer space.

Materials

Part One

- Pail, large
- Water
- Cork, large
- Fishing weights, very small
- Pliers
- Needle
- Fishing line, nylon (12 in.)

Part Two

- Notebook paper
- Stone or small book

OUTCOME 61 (Continued)
Materials (Continued)

Part Three

- Lamp, desk
- Light bulb, 100-watt
- Blindfold

Procedures

Tell students that the earth's environment must be simulated in space in order to protect man. This requires the transport of heavy equipment and supplies aboard a spaceship.

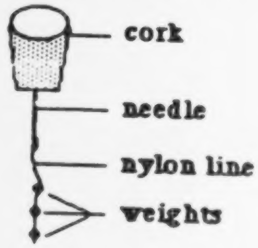
Part One. Zero Gravity (weightlessness) Simulation

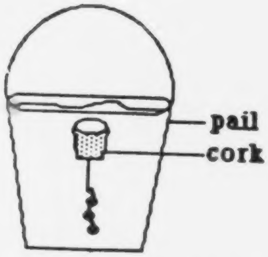
1. Assign students to groups of no more than four. Give each group a large pail, water, a large cork, very small fishing weights, a needle, a pair of pliers, and twelve inches of nylon fishing line.

2. Tell students to fill the pail with water.

3. Instruct students to push the needle into the end of the cork and thread the nylon line through the eye of the needle. Secure the nylon line to the needle with a knot.

4. Ask students to attach fishing weights (squeeze weights on to nylon line with pliers) to nylon fishing line one at a time until the cork neither floats to the top of the water nor sinks to the bottom of the pail when put into water.





5. Ask students to explain how this simulates weightlessness.

   (Neutral buoyancy is achieved when the cork is in a neutral position in the pail of water (suspended in the middle of the pail). This neutral buoyancy is how astronauts train for the zero gravity found in space. The cork represents the astronaut and the pail of water represents the large water tanks astronauts use for training.)

OUTCOME 61 (Continued)

Procedures (Continued)

Part Two. Acceleration (High G-forces)

1. Give each student a sheet of notebook paper and a small object such as a book or stone. (Do not use glass or rubber objects.)
2. Instruct the students to place the sheet of paper on top of a smooth table. Have students place the book or stone on top of the paper.
3. Ask the students to pull the sheet of paper from the book slowly.
4. Instruct the students to repeat the procedure in step two, this time jerking the paper quickly.
5. Ask students to explain how this experiment demonstrates acceleration when the paper is pulled slowly and the paper is jerked.

   (This experiment demonstrates that the acceleration--G-forces--exceeded the friction of the stone or book on the paper. It also demonstrates Newton's First Law of Physics: a body at rest tends to remain at rest.)

Part Three. Radiation Simulation

1. Pair students. Give each pair a blindfold.
2. Ask one student in each group to blindfold the other student.
3. Instruct the student that is not blindfolded to hold the blindfolded student's hand near a lamp approximately two inches away.
4. Ask the blindfolded student to tell when the lamp is on and when the lamp is off.
5. Instruct the students to exchange places and repeat steps one through three.
6. Ask the students to explain how this experiment demonstrates radiation.

   (Heat is radiated through the air just as harmful rays are radiated through space.)

GRADE 5
EARTH SCIENCE

UNIT: Space
TOPIC: Exploration
OUTCOME: 62. Investigate the benefits of space exploration to mankind.

Background

The space age began on October 4, 1957, when Russia launched Sputnik I. Since 1957, more information about the universe has been discovered than during all history. Aerospace research has brought innovations in virtually every field of science and technology. This vast storehouse of knowledge has become a national asset that provides benefits for all life on earth.

Today, approximately eighty-five percent of a person's life is affected by space technology. Some space technologies, such as satellites, are easily recognized as direct contributions of space research. Earth-orbiting satellites have revolutionized communications, weather forecasting, and observations of Earth.

Other space technologies, such as spin-offs, are not easily recognized even though they have penetrated virtually every facet of daily life. Spin-offs are transferred to uses different from their original aerospace application, which make them unknown to many of us. Some 30,000 spin-offs have enriched the lives of untold millions in the areas of computers, medicine, consumer products, fabric structures, industry, and the environment.

This activity will allow students to investigate some of the benefits of space exploration to mankind. Specifically addressed will be satellites and spin-offs.

Materials

- Reference materials (Note: NASA has many publications on the benefits of space exploration to society.)

Procedures

1. Assign students to nine groups.
2. Tell students that the benefits of space applications to mankind are many. Explain that some benefits are easily recognized (satellites) and some are not easily recognized because their applications are different from the original aerospace application (spin-offs).

OUTCOME 62 (Continued)
Procedures (Continued)

3. Write a list of space technologies on the chalkboard that have been beneficial to mankind, such as communication satellites, weather satellites, earth observation satellites, computer spin-offs, engineering structural materials (fabrics, metal alloys, and plastics), consumer product spin-offs, health and medicine spin-offs, sports and recreational spin-offs, and architectural spin-offs.

4. Assign each group of students one item from the list.

5. Ask the groups assigned satellites to conduct research concerning the history, development, purposes, benefits, and useful applications of the specific satellite selected.

6. Encourage all students to write to NASA for any free materials.

7. Instruct the groups assigned spin-offs to conduct research concerning history, development, purpose of space application, and benefits for life on the earth for each specific spin-off.

8. Ask each group to prepare a class presentation using pictures, drawings, diagrams, developmental time lines, or actual spin-off products.

9. After group presentations are completed, ask students to analyze statements such as the following:

    a. Knowledge accumulated from space exploration is a national asset.

    b. Communication satellites have united the world with split-second global communications by voice, television, and computer.

    c. Data from the earth's observation satellites will help in the wise management of the earth's resources for both present and future generations.

    d. Data from weather satellites are beneficial to food supplies, travel, and recreation.

    e. Space spin-offs have helped lengthen life spans, improve living conditions, and improve efficiency in industry and business.

OUTCOME 62 (Continued)
Procedures (Continued)

f. The future will present new uses of knowledge gained from space exploration.

Extensions

1. Ask students to write a list of benefits gained as a result of earth-observation satellites.
2. Have students collect newspaper and magazine clippings of current ways in which space programs benefit mankind.
3. Divide the class into groups. Assign each group a local industry, a member of the medical profession, or an environmental group to interview. Instruct students to note ways in which satellites or space spin-offs are being used in each area.
4. Instruct students to collect pictures of planets taken from satellites and compare them with pictures taken with Earth-based telescopes.
5. Ask students to compile a list of consumer products that are used as a part of the space program as well as in daily lives. If possible, ask students to collect these products to share with the class.
6. Ask students to research a list of space spin-offs used in the manufacture of automobiles.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: States of Matter
OUTCOME: 63. Discover effects of heat or cold on molecules of matter.

Background

Matter is anything that occupies space and has weight. Matter can take one of three forms: solid, liquid, or gas. Matter can be changed from one form to another by heating or cooling. These changes in matter are called physical changes because only the physical properties are changed, not the substance itself. Chemical changes can also take place. In a chemical change, a new substance is formed.

Matter is composed of molecules. When inducing a physical change by applying heat, the molecules move faster, producing heat energy. When the change involves the application of cold temperatures, the molecules move more slower. Generally, with the exception of water, solids and gases expand when heated and contract when cooled.

This activity will require forty-five minutes to initiate and fifteen minutes to conclude when solids have resolidified. Access to a freezer compartment is necessary to complete the activity.

Materials

- Flask, pyrex
- Balloon
- Hot plate
- Pie pan filled with ice and water

For each group:
- Ice cubes
- Margarine (1 tbsp.)
- Shortening (1 tbsp.)
- Wax (1 tbsp.)
- Plastic bags (4) or plastic wrap
- Candle and match
- Pie pan, aluminum
- Clothespin, wooden
- Foil for candle, 6" x 6" square
- Safety goggles (1 pair)

Procedures

1. Discuss with the students the information contained in the Background section.

OUTCOME 63 (Continued)

Procedures (Continued)

2. Tell students to observe the following experiment and think about how heat and cold temperatures affect air. Give examples.

3. Place a balloon over a pyrex flask.

4. Place the flask on a hot plate for one minute on high heat.

5. Instruct students to observe the balloon. (It will expand due to the rapidly moving molecules in the air.)

6. Place the same flask in an aluminum pie pan filled with ice and water.

7. Instruct students to observe the balloon. (The molecules will slow down and the air will cool and contract causing the balloon to deflate.)

8. Ask students to apply what they know about the speed of molecules when heated and cooled, and develop an explanation of the balloon expanding and contracting.

9. Discuss the students' explanations and review the expansion and contraction of air molecules when heated and cooled.

10. Divide the students into small groups and distribute the materials (shortening, margarine, wax, and ice cubes) that have been placed in plastic bags.

11. Write the following chart on the chalkboard. Ask one student from each group to copy the chart.

EFFECTS OF HEAT OR COLD

Solid	Melting Time (Air)	Melting Time (Hands)	Melting Time (Heat)	Cooling Time (Refrigerator)
Shortening				
Margarine				
Wax				
Ice cube				

12. Explain to the students that the activity will compare the heating and cooling times of selected solids.

13. Ask students to observe which solids take longer to melt. Write the results on the chart.

14. Instruct the students first to place the plastic bags containing the solids on a flat surface and leave them at room temperature for five minutes. Direct them to write any changes noted after five minutes.

15. Then, have students hold the solids in the plastic wrap or bags in their hands for five minutes. Have students write any changes in the space provided on the chart and note the time when any solid melts completely.

16. Direct the students to remove any remaining solids from the plastic wrap and place them in an aluminum pie pan. Remind the students to wear safety goggles to protect their eyes.

17. Direct students to use a wooden clothespin to hold the side of the pie pan and to place the pan over the flame of a candle. (Secure the candle on the 6" x 6" piece of aluminum foil.)

18. Have students place the pie pans with the melted solids in the freezer compartment of the refrigerator.

19. Tell students to check the pan every thirty minutes and write only changes that occur until freezing takes place.

20. Discuss the students' findings recorded on the data charts.

21. Ask students why some solids melted or cooled faster than others. (Molecules in certain solids are structured so they are closer together than others. These take a greater amount of heat to melt them than solids with less densely packed molecules. When cooling certain solids, it takes longer to remove the heat, retard the molecules, and restructure them closer together.)

    NOTE: When water is cooled to 32^oF (freezing point), it begins to expand instead of contract. It is an exception to the expansion/contraction rule. Rubber also expands when cooled and is an exception.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: States of Matter
OUTCOME: 64. Discover the effect of heat on water.

Background

When heat energy is added to water, the molecules move more rapidly. The greater the amount of heat applied, the farther apart the molecules move until they are very far apart. At this point the liquid evaporates and becomes a gas. Conversely, when heat is withdrawn, the molecules move closer together, and the gas condenses to become a liquid once again.

Materials

For each group:
- Test tube
- Clothespin, wooden
- Container of water, small
- Candle and match,
- Pie plate, aluminum
- Goggles
- Water, small container (several)

For each student:
- Loose leaf paper

Procedures

1. Discuss with students that matter is anything that has mass and occupies space. Tell students that a liquid has a certain volume and takes the shape of the container in which it is placed. State that water is matter, and that it is a liquid.

2. Tell students that the molecules of which water is composed (hydrogen and oxygen) will react when heated.

3. Pair students, and distribute all materials.

4. Direct students to melt a small amount of wax in the bottom of the pie pan in order to secure their candles. Next, pour water into the test tubes until there is about one inch (five milliliters) of water in the test tube.

5. Have students put on goggles, attach the wooden clothespins (test tube holders) to the test tubes, and light their candles.

OUTCOME 64 (Continued)
Procedures (Continued)

6. Have students extinguish the matches by dipping them into small containers filled with water.

7. Ask students to observe the water carefully and write any observations on their sheets of paper.

8. Direct the students' attention to the sides of the test tube where water vapor is condensing.

9. Have students observe the opening of the test tube when the water reaches the boiling point.

10. Explain to the students that what they are seeing is water vapor, a gas that is formed when water is heated to the boiling point.

11. Direct each student to draw a picture below the observations, on his or her paper depicting two of the states of the matter: test tube with water, test tube with boiling water, and test tube with steam rising from the top.

12. Ask students to explain what happens to the molecules of water when heat is applied. (Molecules begin moving rapidly and further apart until they are as far apart as gas molecules. At this point water molecules become a gas or water vapor.)

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Structure of Matter
OUTCOME: 65. Discover that matter is composed of small particles called molecules.

Background

All matter is composed of molecules, and molecules are composed of atoms. In most cases, a molecule of matter contains more than one atom; however, a neon molecule contains a single atom. The main parts of atoms are composed of even smaller particles called electrons, protons, and neutrons. An electron has a negative electrical charge, a proton has a positive electrical charge, and a neutron has neither a positive or negative charge. Atoms differ only in the number of electrons, protons, and neutrons they have. Because of the electrical nature of atoms, scientists believe that matter itself is electrical in nature. Molecules are bound together by electrical force; for example, two atoms of hydrogen plus one atom of oxygen bond together to form one molecule of water (H_2O). One molecule of matter cannot be detected by the eye, but clusters of them become visible.

Materials

For each group:
- Glass of water
- Food coloring, any color
- Droppers, medicine
- Reference books

Procedures

1. Divide the class into small groups. Distribute a glass of water, food coloring, and a medicine dropper to each group. Have students drop a large drop of food coloring into a glass of water. Tell them to observe the action of the colored molecules on the clear molecules of water. Record observations. (The water appears still, but the color soon spreads in all directions. In a short time, the glass of liquid will be a pale color.)

2. Use the following questions to encourage students to discuss their observations.

   a. If the molecules were not moving, what would happen to the food coloring?

   b. What would happen to the clear water?

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Structure of Matter
OUTCOME: 66. Discover the effects of heat or cold on molecules of matter.

Background

Freezing, melting, and boiling are physical changes of matter because the particles that compose matter are not changed. In this activity, students will discover the effects of heat or cold on molecules of matter. Students will add and remove heat energy to cause physical changes of matter.

It will take two days to complete this activity. Much of the first day will be spent preparing the water cartons for freezing. On the second day, the students will examine the expanded, frozen cartons caused by the removal of heat energy. Also, on the second day the students will observe how water vapor (a gas) expands with heat using more space (the expanded foil over the pan.)

Materials

- Water
- Hot plate
- Pan, small
- Foil (approximately 30 cm square)

For each group:
- Milk or juice carton, small
- Tape, masking (1 strip)
- Markers

For each student:
- Handout: PHYSICAL CHANGES

Procedures

Day One

1. Assign students to small groups of four or five students.

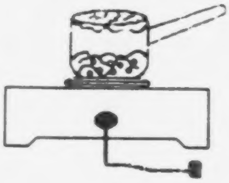
2. Distribute handout PHYSICAL CHANGES, cartons, water, tape, and marking pens to each group. Tell students to fill the cartons with water. Tell students to tape the cartons closed, and label the cartons with their names or group numbers.

OUTCOME 66 (Continued)
Procedures (Continued)

3. Tell students to complete items one through three on the handout PHYSICAL CHANGES.
4. After students have prepared the water cartons, collect and place them in the school freezer for one day.

Day Two (Demonstration by teacher)

1. Fill pan with approximately one cup of water. Crinkle the foil so that it is not smooth, then use it to cover the pan. Do not uncrinkle the foil, but make sure pan is completely covered so that no steam can escape until later.
2. Ask students to predict what will happen. (The liquid state of water will change to water vapor. Then the crinkled foil will dome as the water changes to steam, a gas.)



3. Place pan on hot plate. Turn heat on high.
4. As the foil domes, ask the students to tell why this is happening. (The particles spread out, and a gas takes up more space than a liquid.)
5. Carefully remove foil. Allow students to observe the boiling water. Point to the water vapor rising from the pan.
6. Discuss the effects of heat on molecules of matter.
7. Send for frozen cartons, and distribute them to the groups.
8. Ask students to complete the handout PHYSICAL CHANGES.

PHYSICAL CHANGES
Handout

Day One

1. Describe the condition of the carton and its contents.

2. Draw what you see.

3. Describe what must be done to change a liquid to a solid.

Day Two

1. Describe the condition of the carton and its contents.

2. Draw what you see.

3. Describe what happened.

4. What kind of energy caused the liquid to change to a solid? Was the energy added or removed?

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Structure of Matter
OUTCOME: 66. Discover effects of heat or cold on molecules of matter.

Background

Three of the states of matter are solid, liquid, and gas. A fourth state, plasma, exists under specific conditions. Metal is a solid; water is a liquid, and the air we breathe is a gas. Matter can be changed by heating and cooling processes. Ice is frozen water; it melts to a liquid when heat is applied. Water changes into steam, a gas, when it is boiled. The molecular composition of water, however, does not change when it is heated or cooled. Solids have definite shape and volume. The molecules of solids are packed more tightly than are the molecules of liquids or gases, so there is less room for movement (vibration) of molecules in solids. Liquids have no definite shape, but take the shape and volume of the container they fill. The molecules of liquids have greater spaces between them. Because the atoms are not as densely packed as they are in solids, they can move and vibrate more freely in a liquid state. The atoms of gas molecules are even more loosely packed than those of liquids; therefore, the atoms in gases vibrate freely. Gases have no definite shape.

Materials

For each group:
- Ice cubes
- Bowls
- Clock
- Handout: TIME CALCULATIONS
- Mirror

Procedures

1. Divide the students into groups. Distribute the handout TIME CALCULATIONS and an ice cube to each group. Be sure all ice cubes are similar in size.

2. Instruct the students on the correct method of completing the handout TIME CALCULATIONS.

3. Tell them to record the time that the ice cubes were set at room temperature.

4. Have them predict the time required for the ice to melt or become a liquid. When the ice melts, have them record the actual melting time and compare it with the predicted melting time.

257

OUTCOME 66 (Continued)
Procedures (Continued)

5. After the ice melts, tell the students to predict the time required for the water to evaporate or become a gas. When the bowl that contains the water becomes dry, have students record the actual time for evaporation.

6. Direct students to calculate the time spans on the handout TIME CALCULATIONS.

7. Put a mirror in a freezer until it becomes very cold. Ask students to blow warm breath on it and observe the droplets of moisture that form on the mirror. These droplets are known as condensation. Students will infer that matter can be changed from one form to another without changing the substance.

TIME CALCULATIONS
Handout

Matter	Beginning Time	Ending Time	Total Time
Solid			
Liquid			
Gas			
*			

*Other substances can be frozen and used.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Structure of Matter
OUTCOME: 67. Discover that molecules are composed of particles called atoms.

Background

Elements are made of only one kind of atom. A molecule is made of two or more atoms joined together. (Neon is an exception, as one atom of neon makes one molecule.) Symbols are used to represent the different elements in a molecule. This activity will help students learn the composition of some molecules.

Materials

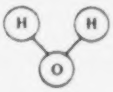
For each group:
- Modeling clay, red, blue, and yellow
- Toothpicks, round (1 box)
- Stick pins, 1 cm (17)
- Paper
- Index cards, 3"x5" (5)
- Scissors

Procedures

1. Divide the class into small groups.

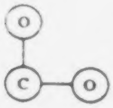
2. Draw the following illustrations on the chalkboard and label molecules of water, carbon dioxide, methane gas, carbon monoxide, and hydrogen peroxide. (See illustration.)

A.



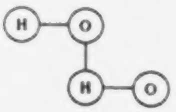
Water - H_2O

B.



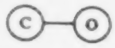
Carbon dioxide - CO_2

C.



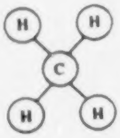
Hydrogen peroxide - H_2O_2

D.



Carbon monoxide - CO

E.



Methane gas (swamp gas) - CH_4

OUTCOME 67 (Continued)
Procedures (Continued)

3. Explain that each circle in the diagram represents an atom and that these atoms are combined to form molecules.

4. Explain that the letters show the type of atom the circle represents. (C represents carbon, O represents oxygen, and H represents hydrogen.)

5. Emphasize that the small number next to some letters illustrates the number of atoms of a particular element found in a molecule. (H_2O illustrates that a molecule of water is composed of two atoms of hydrogen and one atom of oxygen.)

6. Direct the students to copy the drawings from the chalkboard.

7. Assign a separate color of clay to represent each element:

   a. Hydrogen-red
   b. Oxygen-blue
   c. Carbon-yellow

8. Distribute the clay.

9. After the drawings have been copied and discussed, direct the students to prepare labels for each atom. Cut labels one centimeter square. Refer to the drawing of the models on page 235 for the correct symbol--C, H, or O.

10. Next, have students roll clay into small balls, equal in size, to make atoms for the molecule models. Mold each clay ball the size of a marble.

11. Tell students to label each ball of clay with the correct element symbol (C, H, or O.)

12. Have students use one stick pin to attach each label to the appropriate ball of clay. Caution the students to be careful when using stick pins.

13. Give each group of students five index cards. Tell them to write the name of a single compound on each card. (The cards should include both the name of the compound and the formula for making that compound. (Example: water--H_2O)

14. Display the students' work.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Structure of Matter
OUTCOME: 67. Discover that molecules are composed of particles called atoms.

Background

The smallest particle of an element is the atom. Atoms do not usually exist alone; they often combine into molecules. A molecule is two or more atoms bonded together. Molecules form elements and compounds. Elements consist of molecules made of only one kind of atom. Compounds consist of molecules that are made of different kinds of atoms; for example, a molecule of hydrogen (an element) is made of two hydrogen atoms. A molecule of water (a compound) is made of two hydrogen molecules and one oxygen molecule. Scientists use symbols and formulas as a shorthand for writing the names of the elements and the number of atoms in a molecule; for example, H_20 is the formula for water. H is the symbol for hydrogen. 0 is the symbol for oxygen. The subscript 2 is used to show that the molecule contains two hydrogen atoms. No number after the 0 symbol means only one atom of oxygen is present. This activity should be taught after a lesson on elements and symbols.

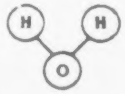
Materials

For each student:
- Handout: PERIODIC TABLE OF THE ELEMENTS
- Handout: ELEMENTS

Procedures

1. Distribute the handout PERIODIC TABLE OF THE ELEMENTS.

2. Write the formula H_20 on the board. Ask the students if they know what compound this formula represents. (Someone probably will know.) Explain that water is made of the two elements hydrogen and oxygen. Explain that it takes two atoms of hydrogen and one atom of oxygen.



Water - H_2O

OUTCOME 67 (Continued)
Procedures (Continued)

3. Write the formula (NaCl), for table salt on the board. Ask students to identify the elements in table salt by looking at the formula. (Someone will answer sodium and chlorine.) Ask how many atoms of each are indicated in the formula. (One atom of each element.) Tell the students that it takes two atoms to make one molecule of table salt.

4. Write another formula ($NaHCO_3$) on the board. Tell the students to write the formula on their papers and attempt to list the elements and the atoms in the formula. Discuss after a few minutes.

Baking soda:	$NaHCO_3$:	sodium	1
		hydrogen	1
		carbon	1
		oxygen	3

5. Distribute the handout ELEMENTS, and ask students to complete it by filling in the blanks. Monitor student activity.

PERIODIC TABLE OF THE ELEMENTS
Handout

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 C	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104	105	106	107	108	109									

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lw

ELEMENTS
Handout

Compound	Formula	Element	Number of atoms of each element
Sugar	$C_{12}H_{12}O_{11}$	______	____
		______	____
		______	____
Copper Sulfate	$CuSO_4$	______	____
		______	____
		______	____
Lye	______	sodium	1
		oxygen	1
		hydrogen	1
*Hydrogen Chloride	______	hydrogen	1
		chlorine	1
**Hydrogen Sulfate	$H_{22}SO_4$	hydrogen	____
		sulfur	____
		oxygen	____

* A water solution of hydrogen chloride is called hydrochloride acid.

** A water solution of hydrogen sulfate is called sulfuric acid.

ELEMENT SHEET
Key

Compound	Formula	Element	Number of atoms of each element
Sugar	$C_{12}H_{22}O_{11}$	carbon	12
	hydrogen	22	
	oxygen	11	
Copper Sulfate	$CuSO_4$	copper	1
	sulfur	1	
	oxygen	4	
Lye	$NaOH$	sodium	1
	oxygen	1	
	hydrogen	1	
Hydrogen Chloride	HCl	hydrogen	1
	chlorine	1	
Hydrogen Sulfate	$H_{22}SO_4$	hydrogen	22
	sulfur	1	
	oxygen	4	

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Elements, Compounds, and Mixtures
OUTCOME: 68. Explain the composition of elements, compounds, and mixtures.

Background

An element is a substance composed of atoms with the same number of protons in their nuclei. (The number of neutrons can vary.) There are 92 natural elements and 17 artificial ones (11 artificial, 6 others reportedly have been discovered) for a total of 109 known elements. Compounds are formed when two or more elements are combined and their atoms are chemically bonded. Mixtures are combinations of two or more substances that are not chemically bonded and that can be separated by physical or mechanical means; no new substance is formed. This activity will help students understand the composition of elements, compounds, and mixtures.

Materials

- Poster board
- Markers
- Reference books
- Handout: NAMES AND SYMBOLS OF ELEMENTS
- Hot plate
- Sauce pan, one-quart
- Boiling water (1c.)
- Sugar (2 c.)
- Glass, eight oz.
- String, cotton
- Paper clip
- Pencil
- Food coloring, any color (optional)

Procedures

1. Explain that symbols stand for single elements and elements in compounds. Give examples on the chalkboard from the PERIODIC TABLE OF THE ELEMENTS. Direct the students to complete the handout NAMES AND SYMBOLS OF ELEMENTS, placing symbols by each element and compound. Tell them that numerals by the symbols represent the number of atoms in each element, and this is called a formula.

OUTCOME 68 (Continued)
Procedures (Continued)

2. Direct the students to perform an experiment that shows how a mixture is separated into a compound (sugar) and elements (oxygen and hydrogen). Have them mix sugar with boiling water so that crystals will be formed as the sugar separates from the water.

   Add two cups of sugar to a cup of boiling water. Stir until the sugar dissolves. Let the mixture cool, then pour it into a glass. Tie a piece of cotton string to a pencil. Tie a paper clip on the other end of the string. Place the string in the glass and the pencil across the top of the glass. Let mixture stand for a few hours. (After a few hours, crystals will form on the string as the water evaporates.) If a crust forms on the water, remove it. Tell the students after two or three days the crystals will be ready to eat. (This is how rock candy is made.) To make colored crystals, add food coloring to the hot water. Add more strings of rock candy if desired.

3. Ask students to bring labels of elements, compounds, or mixtures to class.

4. Direct the students to divide the products and product labels and classify them according to element, compound, or mixture. Have students place products and labels on a display table.

NAMES AND SYMBOLS OF ELEMENTS
Handout

Hydrogen -

Oxygen -

Iron -

Mercury -

Nitrogen -

Sulfur -

Copper -

Sodium -

Chlorine -

NAMES AND SYMBOLS OF COMPOUNDS

Carbon dioxide -

Salt -

Table Sugar -

Sulfuric acid -

Hydrogen peroxide -

Water -

NAMES OF COMMON MIXTURES AND COMPONENTS

Soup -

Air -

Fruit salad -

Soft drink -

Cake batter -

Lemonade -

Pizza -

NAMES AND SYMBOLS OF ELEMENTS
Key

(This chart is for teacher reference.)

Hydrogen - H

Oxygen - O

Iron -Fe

Mercury -Hg

Nitrogen -N

Sulfur -S

Copper -Cu

Sodium -NA

Chlorine -Cl

NAMES AND SYMBOLS OF COMPOUNDS

Carbon dioxide - CO_2

Salt - NaCl

Sugar - $C_6H_{12}O_6$

Sulfuric acid - H_2SO_4

Hydrogen peroxide - H_2O_2

Water - H_2O

NAMES OF COMMON MIXTURES AND COMPONENTS

Soup - vegetables, water, spices, meat

Air - gases: oxygen, nitrogen, hydrogen

Fruit salad - fruit

Soft drink - water, flavoring, and carbon dioxide

Cake batter - flour, eggs, shortening, milk, sugar

Lemonade - lemon juice, sugar, water

Pizza - flour, vegetables, cheese, meat

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Physical and Chemical Changes
OUTCOME: 69. Explain a physical change in matter.

Background

A physical change in matter occurs when there is a change in the size, the shape, or the state of matter. The atoms and molecules of the matter do not change during a physical change. The matter might change in appearance, but it contains the same atoms and molecules.

Materials

- Ice cubes, in a small bowl
- Saucer or small dish

For each student:
- Construction paper, dark-colored (1 sheet)
- Chalk, white (1 stick)

Procedures

1. Explain to students that a physical change in matter occurs when there is a change in the size, the shape, or the state of matter.

2. Point to the shape and appearance of the ice cubes in the small bowl. Set them aside.

3. Distribute construction paper and chalk to each student.

4. Tell students to observe the chalk closely.

5. Tell students to draw a picture on the construction paper with the chalk, coloring as much of it as possible.

6. After approximately five minutes, instruct students to observe their chalk again. Ask how the chalk has changed. (The used chalk is smaller and shorter.) Emphasize that there has been a change in the size of the matter, but the atoms and molecules are still the same.

7. Explain that changes in size and shape are common physical changes. Tell the students that tiny bits of chalk are rubbed from the stick onto the construction paper; however, the bits of chalk are still chalk.

OUTCOME 69 (Continued)
Procedures (Continued)

8. Point to the shape and appearance of the ice cubes. Ask students to describe what has happened. (The ice has melted.) Remind students that ice is the solid state of water. Explain that there has been a change in the state of the matter, but the atoms and molecules are still the same. Point out why this is an example of a physical change in matter.

9. Show the students the saucer (or small dish). Place the saucer (or dish) inside a paper bag and drop it to the floor or hit with a hammer. Following all safety precautions, display the pieces of broken saucer. Ask students to explain why or why not this has been a physical change in matter. (There has been a change in shape, but the broken pieces are still made up of the same matter.)

10. Ask students to give other examples of physical changes in matter.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Physical and Chemical Changes
OUTCOME: 70. Demonstrate a chemical change in matter.

Background

A chemical change in matter alters the appearance and the composition of the matter. (In a physical change in matter, the original substance remains the same although the size, shape, or state of the matter may change.) A chemical change in matter produces a new substance or substances that have new physical and chemical properties. An energy change of some kind (heat, light, or electrical energy) either causes the chemical change or occurs during the chemical change.

Some chemical changes take place over a long period of time. An example is rust that forms on the surface of iron when the iron is exposed to the oxygen in the air and moisture. Another example of a slow chemical change is the decay of matter that was once alive and then died. Over a period of time, the matter decays.

Other chemical changes such as the souring of milk, burning of wood, and photosynthesis take place more quickly.

This is a teacher demonstration. Discuss and follow safety precautions.

Materials

- Strips of dry wood, 3" in length (2)
- Matches, safety
- Container, fireproof
- Beaker or jar
- Baking soda (2 tsp)
- Vinegar, white (2 tsp)
- Teaspoon

Procedures

1. Hold the small strips of wood so that students can clearly see them.
2. Ask the students to describe the physical properties of the wood. Write the properties on the chalkboard.

OUTCOME 70 (Continued)
Procedures (Continued)

3. Place the wood in the fireproof container. Strike a match and hold it to the wood so that it burns. Ask students what is released by the fire. (Heat, light, smoke) State that a chemical change usually causes the release of heat, light, or electrical energy.

4. After the wood has burned and ashes are left, ask the students to describe the physical properties of the substances left. Write on the chalkboard as the students describe the ashes.

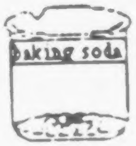
5. Ask students questions such as the following:

   a. Have the physical characteristics of the matter changed? (Yes)

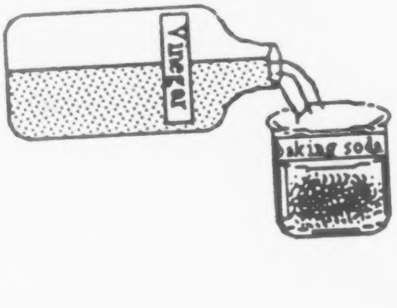
   b. Is the matter that is left the same as the original substance? (No)

   c. Would this be a physical or a chemical change? (Chemical)

6. Put two teaspoons of baking soda in a beaker or jar. Ask students to describe the physical properties of the baking soda.



7. Drop two teaspoons of white vinegar over the baking soda. Ask students to describe what happens. (Bubbles are seen.) Explain that new substances have been formed. One of the new substances is carbon dioxide gas.



OUTCOME 70 (Continued)
Procedures (Continued)

8. Ask students if this has been a physical or a chemical change. (Chemical)

9. Ask students to research and find examples of chemical changes. If possible, have students bring in pictures of matter that demonstrate chemical changes. Display pictures on the bulletin board.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Physical and Chemical Changes
OUTCOME: 70. Demonstrate a chemical change in matter.

Background

In a chemical change, the chemical properties of matter are changed so that a new substance is formed. The properties of the new substance are different from those of the original substance. Some examples of chemical changes are the digestion of food, the burning of wood, and the rusting of nails. In order for a chemical change to occur, energy (heat, light, electricity) is needed or is released.

Materials

For each group:
- Matches
- Pie pans, aluminum
- Nails
- Jars
- Water

Procedures

1. Assign students to groups of no more than two or three, and distribute the materials to each group. Caution them to observe all the safety rules dealing with fire and matches.

2. Have students place a lighted match on the pie pan. Leave the match undisturbed until it burns out.

3. Direct students to observe that the match is no longer a match and that black remains are in the pie pan along with ashes. Explain that carbon is in the black substance that remains, and carbon dioxide and water vapor are released into the air.

4. Ask some students to feel an unburned match and then feel the cooled remains of the match in the pie pan. Direct students to notice the substance on the finger that touched the burned match. Explain that this is carbon.

5. Explain to students that they can observe a chemical change of corrosion by examining four or five nails (not galvanized) that have been set in a jar of water over several days. Have students record their findings and tell what kind of change took place.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Physical and Chemical Changes
OUTCOME: 71. Compare a physical change and a chemical change in matter.

Background

Properties of matter can be classified as physical and chemical. Most changes in matter can be classified in the same way. Physical change does not alter the identity of a substance; for example, wood can be carved into a duck or other object. Its shape is altered, but its substance is not changed. Chemical change alters the material as it reacts to certain substances; for example, the carved wood figure changes into carbon when the oxygen in the wood combusts with a match and carbon dioxide and water vapor are released into the air. The black residue (carbon) is evidence of a chemical change.

Prior to this activity, items which are classified as representing a physical or chemical change need to be collected for a display table.

The activity requires two days for completion.

Materials

- Table for display

For each group:
- Clear cup or baby food jar
- Water
- Seltzer tablet
- Several bits of tissue
- Soil
- Bits of chalk
- Tea bag
- Steel wool
- Soap
- Beans, dried
- Handout: TABLE OF PHYSICAL AND CHEMICAL CHANGES

Procedures

1. Assign this project to groups of three to five students. Every student will view the display and decide whether the material has undergone a physical or a chemical change.

OUTCOME 71 (Continued)
Procedures (Continued)

2. Each group will fill each cup or jar half full of water. Give each group one of the following materials: a seltzer tablet, bits of tissue, soil, bits of chalk, a tea bag, steel wool, liquid soap, or dried beans.

3. Have each group add its material to the water in the jar and stir the contents.

4. Have one student from each group record the results on the handout TABLE OF PHYSICAL AND CHEMICAL CHANGES and then discuss the group's observations.

5. Let the cups sit overnight so that students can observe any changes the next day.

   (Students may begin completing the TABLE OF PHYSICAL AND CHEMICAL CHANGES on the first day of the activity and finish it on the second day.)

6. Discuss the information on the completed handouts and the noted differences between chemical and physical changes.

TABLE OF PHYSICAL AND CHEMICAL CHANGES
Handout

Material	Reactions First day	Reactions Second day	Kind of Change
1. Seltzer tablet	fizzes when dropped in water	clear liquid	chemical
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			

TABLE OF PHYSICAL AND CHEMICAL CHANGES
Key

Material	Reactions First day	Reactions Second day	Kind of Change
1. Seltzer tablet	fizzes when dropped in water	clear liquid	Chemical
2. Salt	dissolves	(answers may vary)	Physical
3. Tissue	paper fragments	" "	Physical
4. Soil	soil disperses	" "	Physical
5. Bits of chalk	film on water	" "	Physical
6. Tea bag	bag colors water	" "	Physical
7. Steel wool	iron rusts	" "	Chemical
8. Oil	floats on water	" "	Physical
9. Soap	sudsy water	" "	Physical
10. Dried beans	plump after a day	" "	Physical
11. *			

* Use any material.

GRADE 5
PHYSICAL SCIENCE

UNIT: Matter and Energy
TOPIC: Physical and Chemical Changes
OUTCOME: 71. Compare a physical change and a chemical change in matter.

Background

Physical properties of matter change when there is a chemical change. When iron and sulfur are stirred together, a physical change takes place, and the two elements can be separated easily by passing a magnet over the mixture because iron is attracted by a magnet. When iron and sulfur are heated together, a chemical change takes place, creating a whole new substance, and the elements cannot be separated.

Materials

For each group:
- Magnets (1 per group)
- Petrie dishes (3 per group)
- Sulfur (1 teaspoon)
- Iron powder (1 teaspoon)
- Iron sulfide (1 teaspoon)

Procedures

1. Assign students to groups of four or five.

2. Place approximately one teaspoon of sulfur, iron powder, and iron sulfide in separate petrie dishes for each group, labeled "A", "B", and "C."

3. Tell students to define physical change on one sheet of paper and chemical change on another sheet of paper. Textbooks may be used. (Example: physical change--a change in the size, shape, or state of matter; chemical change--a change in matter in which one or more different kinds of matter form.)

OUTCOME 71 (Continued)

Procedures (Continued)

4. Distribute two of the petrie dishes labeled "A" (sulfur) and "B" (iron) to each of the groups.

5. Instruct students to mix the two elements together in one dish.

6. Distribute petrie dishes labeled "C" (iron sulfide) to each group. Explain that iron sulfide is made of the elements sulfur and iron.

7. Ask students to compare the two dishes (the dish of the sulfur and iron mixture with the dish of iron sulfide.) Discuss the differences.

8. Ask students to describe the contents of the petrie dishes using the definitions of physical change and chemical change.

9. Distribute magnets. Instruct students to pass the magnets over the sulfur and iron mixture. Discuss results. (Iron is pulled from the mixture, leaving the sulfur.) Pass the magnet over the iron sulfide. Discuss results. (No change to the material.)

10. Explain to students that the magnet attracts the iron when a physical change has been accomplished, but a new substance (iron sulfide) is formed when a chemical change caused by heat takes place. There is no attraction of the iron to a magnet in iron sulfide. The two elements cannot be separated when a chemical change takes place.

GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Production and Characteristics of Sound
OUTCOME: 72. Explain how sound is produced.

Background

A vibrating object causes the molecules of air in front of it to press closer together, creating compression. As the vibrating object moves backward, it leaves a space with fewer and less densely packed molecules, creating rarefaction. One compression and one rarefaction make one vibration. Vibrations create sound waves which differ in shape, size, and height. Vibrations can be both audible to the human ear and visible to the eye. Conversely, many vibrations (sound waves) can be detected only with the use of special equipment. A vibrating object may move up and down, from front to back, or from side to side. Sound is a form of energy which is produced by a vibrating body or object. There is no sound if there are no vibrations; hence, sound cannot occur in a vacuum.

This activity helps students understand how sound is produced. Before class, five stations should be set up and a laboratory card should be prepared for each station. Note that station number 5 requires the teacher to make drawings on the chalkboard prior to the activity. Example illustrations and example laboratory cards are provided.

Materials

- Plastic rulers of different lengths, flexible
- Container of water
- String (1 foot)
- Pencil
- Alarm clock, spring wound
- Pot lid with handle (or cymbal)
- Spoon, large (or mallet for cymbal)
- LABORATORY CARD:
  Station 1: Rulers
- LABORATORY CARD
  Station 2: Alarm Clock
- LABORATORY CARD
  Station 3: Pot Lid and Spoon
- LABORATORY CARD
  Station 4: Container of water, pencil, and string
- LABORATORY CARD
  Station 5: Chalkboard and Drawings
- Illustrations for Station Five

OUTCOME 72 (Continued)

Procedures

1. Explain sound production, vibrations, and sound waves to the students. Tell the students that they are going to be experiencing vibrating sensations as well as observing some vibrating materials, and that they will be writing about their experiences. Explain that everyone will work with the same materials.
2. Ask the students to place two fingers over the larynx (voice box) and hum. Call for silence after a few seconds and ask if there were any who did not feel the vibrations of the voice. Give assistance, if necessary.
3. Divide the class into five groups. Assign each group to a specific station. Begin the group work. Ask students to work as quietly as possible even though some of the materials can make loud noises. Check the alarm to make sure it is wound and set so that it will sound off when the stem is pulled.
4. Direct the students to read the laboratory card at each station, follow the directions, and write observations in their science notebooks.
5. Call time for each group to move to another station after the designated time has elapsed.
6. Conduct a general discussion that includes a sharing of the students' observations regarding sound production.

Extensions

1. Study the shapes of several sound patterns.
2. Use a flexible, coiled wire ("slinky") to demonstrate compression and rarefaction.

LABORATORY CARD
Station 1: Rulers

Materials

- Flexible plastic rulers of different lengths
- Table or desk top

Procedures

(Each student will go through the process.)

1. Place a ruler on the table or desk top so that one-half of the ruler rests on the table top and one-half extends over the edge.
2. Place a hand firmly over the end of the ruler resting on the table top.
3. Apply pressure quickly to the free end of the ruler; then, quickly release the pressure.
4. Listen carefully for sounds and watch closely for vibrations.
5. Change the position of the ruler by placing more or less of the ruler on the table top. Repeat the process.
6. Repeat the process until each student has experimented with a ruler.

Results (Write in science notebooks.)

- What happened?
- Compare or contrast sounds and vibrations from rulers of different lengths.

LABORATORY CARD
Station 2: Alarm Clock

Materials

- Alarm clock, spring wound

Procedures

1. Work in pairs. (Take turns going through the process.)

2. First student: Hold the clock. Second student: Pull out the stem to let the alarm sound; then, push in the stem to stop the sound. Repeat.

3. Repeat the process until each student has had a chance to hold the clock.

Results (Write in science notebooks.)

- Record your observations.

LABORATORY CARD
Station 3: Pot Lid and Spoon (or Cymbal and Mallet)

Materials

- Pot lid or cymbal
- Large spoon or mallet

Procedures

1. Work in groups of three.

2. First student: Hold the pot lid by the handle.
   Second student: Strike the lid with the spoon.
   Third student: Touch the lid to stop the vibrations.

3. Repeat the process until each student in each group has had an opportunity to strike the lid and also to feel the vibrations.

Results (Write in science notebooks.)

- Record your observations.

LABORATORY CARD
Station 4: Container of Water, Pencil, and String

Materials

- Container of water
- Pencil
- String

Procedures

1. Tie a length of string on the eraser end of a pencil.
2. Place the container of water on the floor.
3. Hold the end of the string and let the tip of the pencil touch the surface of the water.
4. Observe the movement of the water when the tip of the pencil hits the surface.
5. Repeat numbers 3 and 4 until every student has had an opportunity to touch the tip of the pencil to the surface of the water.

Results (Write in science notebooks.)

- Record your observations.

LABORATORY CARD
Station 5: Chalkboard and Drawings

Materials

- Chalkboard
- Drawings on the chalkboard
- Science notebook

Procedures

1. Copy Drawing 1 from the chalkboard in your science notebook.

2. Identify crests (C) and troughs (T) according to the definitions given on the chalkboard.

3. Copy Drawing 2 from the chalkboard in your science notebook.

4. Identify compression waves and rarefaction waves.

Results

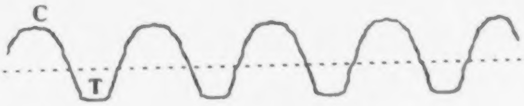
- Record an explanation of each drawing in your science notebooks.

ILLUSTRATIONS FOR STATION FIVE

*NOTE: Do not write the answers for LABORATORY CARD, Station 5: Chalkboard and Drawings when drawing the needed information on the chalkboard.

Draw the following on the board.

Drawing 1: Sound Wave

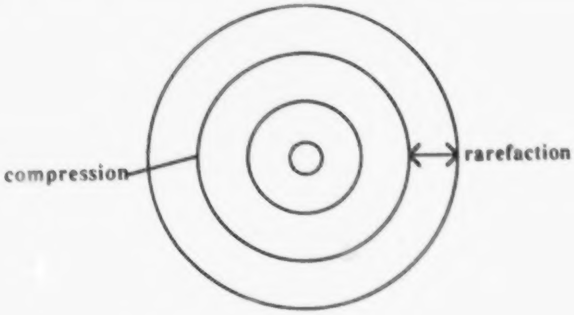


crest: the highest level between waves
trough: the lowest level between waves

Drawing 2: Sound wave

The wave starts from the center and moves outward. Compression waves are also known as condensations.

Compression: area of greatest pressure
Rarefaction: area of least pressure



GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Production and Characteristics of Sound
OUTCOME: 73. Describe characteristics of sound: pitch, volume, and timbre.

Background

Sound has three characteristics: pitch (highness or lowness of sound), volume or intensity (loudness or softness of sound), and timbre (tone quality). Faster vibrations produce higher pitches, and slower vibrations produce lower pitches. Humans with good hearing can detect sounds with frequencies that range somewhere between 20 and 20,000 vibrations per second. Dogs can detect sounds with even higher frequencies.

Volume or intensity of sound depends on several factors: (1) the strength or energy of the vibrations (sound wave), (2) the distance of the listener from the source of sound, (3) the density of the sounding medium, and (4) the area of the vibrating object. Intensity of sound can be measured by a sound-level meter. The unit of measurement is called a decibel.

The timbre (pronounced tamber) or tone quality of sound helps one distinguish the difference between human sounds and animal sounds, and the sounds of nature and noises made by machines. Timbre helps one distinguish the sounds of certain musical instruments; for example, timbre helps one hear the differences between a piano and an organ, a guitar and a banjo, a flute and an oboe, a tuba and a trombone, and others. When an object vibrates, it vibrates as a whole and also in parts at the same time. The lowest sound made by the vibrating medium is called the fundamental tone. The parts that are vibrating at higher frequencies produce faint tones called overtones. The overtones add distinction to the fundamental tone, which helps in the identification of various sounds, voices, and instruments. The size, shape, and material of which the vibrating medium is made determine how many overtones will be produced.

Materials

- Record player with variable speed
- Any recording designed to be played at 33 1/3 revolutions per minute

OUTCOME 73 (Continued)
Materials (Continued)

- Hammer
- Wood plank, approximately 2" x 4" x 12"
- Nails, ten-penny (2)
- Rubber bands, varied lengths and thicknesses
- Bowls (3 lbs., 2 lbs., 1 lb., 1/2 lb.)
- Pencil
- Pen
- Goggles

Procedures

1. Explain the three characteristics of sound. Tell students that the activities will help them understand these characteristics better.

2. Select a student to operate the record player. Have a student place a recording on the turntable and set the speed at 33 1/3 rpm. Ask students to listen carefully as the speed is turned to 45 rpm, then 78 rpm, and 16 rpm. Inform the students of the recording-per-minute (rpm) setting beforehand. Ask them to describe the sounds at different speeds. (This activity will help students understand that faster vibrations produce higher sounds.)

3. Direct two or three students to work with the plastic bowls. Tell them that they are going to use the plastic bowls as drums. Ask them to turn the bowls upside down on a table top in order of size, starting with the largest bowl and ending with the smallest.

4. Ask students to use the ruler as a drum stick. Have all students listen as some students play the drums. Ask students to observe the sounds made by the drums. Have students repeat the experiment with a pencil and a pen. Have them discuss the three characteristics of sound produced by the drums. Ask students if the sound changes in any way when different drum sticks are used to strike the "drums."

5. Choose a student to drive the nails into the board. Caution the student to be careful while this is being done. Direct the student to drive the nails lengthwise in the board, about six inches apart. Tell students to choose three rubber bands of different lengths and thicknesses, and place them over the nails, with spaces between the bands. Call on students to pluck the "strings" of the instrument. Have students experiment by pinching the center of the rubber band and plucking either end. Repeat the experiment with different-sized rubber bands. Ask students to record their observations.

OUTCOME 73 (Continued)

Extensions

1. If the school has a band or orchestra, invite students from those groups to bring their instruments to class for a demonstration of pitch, volume, and timbre.

2. Assign a home project of making a simple drum, a bango, a flute, and others. Have children make their own simple instruments at home and demonstrate them in class. Allow two or three days for completion of the project.

GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Production and Characteristics of Sound
OUTCOME: 74. Explain the uses of sound energy.

Background

Sound is a form of energy resulting from vibrations. When the vibrations cease, so does the sound. Sound travels the fastest and best through materials whose molecules are densely packed. Sound becomes weaker as it moves farther away from its source. Depending on conditions, however, sound may return to its source in the form of reflected sound or echo. In order to hear an echo, sound must be directed toward a large hard surface such as a canyon wall or the wall of a building. The source of the sound must be at least 56 feet away from the reflecting surface or no echo will be heard. The farther away the wall or other reflecting surface, the longer it will take for the sound to return as echo. If the sound bounces off more than one surface, a series of echoes will be produced.

Ultrasonics is the study and application of sound waves with frequencies beyond the range of human hearing (greater than 20,000 cycles per second). Ultrasounds are commonly produced by transducers. Ultrasounds have many applications at present, and their usefulness will certainly increase.

The military uses sonar to detect submarines and other submerged objects. Geophysicists use sound to explore for minerals, oil, and gas. Commercial fishing boats are commonly equipped with sonar which helps in determining the depth of the water and also in locating schools of fish. Ultrasound is used in pasteurizing milk, in cleaning machinery and fine instruments, and in killing bugs.

In medicine, ultrasound is used to view internal parts of the body which might be difficult or impossible to examine by other means. It is a noninvasive procedure which avoids the hazards of other diagnostic methods.

Materials

- Dog whistle
- Reference materials

OUTCOME 74 (Continued)

Procedures

1. Explain the uses of sound energy such as the echo and ultrasound.

2. Encourage students to read the selected reference materials on ultrasound. Have them check the school library to see if they can find additional materials on the subject.

3. Have one student blow the dog whistle. Direct students to discuss what happened. Ask if any of them use a dog whistle at home to call the dog.

4. Ask students to predict future uses of sound energy.

5. Have students complete the following assignment for homework:

   Ask parents if they have had any experience with ultrasound or sonar. If so, what was that experience? Was it during a medical examination? What did the parent feel? Discuss.

GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Speech Organs
OUTCOME: 75. Explain functions of lungs, larynx, lips, tongue, and teeth.

Background

The lungs, larynx, lips, tongue, and teeth act in concert to produce sound. A large sheet of muscle known as the diaphragm is responsible for forcing air into and out of the lungs. (The diaphragm is located between the chest and the abdomen.) The lungs provide the air needed for tone production. Most sounds are produced during exhalation. The larynx (voice box) contains a set of vocal cords that are set into motion (they vibrate) when air from the lungs passes over them. Muscles in the throat tighten the vocal cords to produce higher sounds and loosen them for lower sounds (higher and lower pitches.) The amount of air passing by the vocal cords determines loudness or softness (volume or intensity.) The throat, mouth, lips, tongue, and teeth are the instruments for phonetic shaping of sounds. Individual differences in these speech organs, as well as differences in their resonating cavities, give voices their distinctive qualities.

Materials

For each group:
- Reference materials with a diagram of the respiratory system

Procedures

1. Divide the class into five groups and distribute each group reference materials containing a diagram of the respiratory system.

2. Direct each group to draw the respiratory system from the reference materials provided.

3. Direct students to exhale most of the air from their lungs, then attempt to carry on a conversation without breathing air into their lungs. Ask students to use their diagrams of the respiratory system to explain what happens.

4. Call a student volunteer to the front of the room for a demonstration. Ask the student to hold his or her lips open and keep them as still as possible while reading a short paragraph. Ask the class how well they understood the reading. Discuss the function of the lips in speech.

OUTCOME 75 (Continued)
Procedures (Continued)

5. Call another student volunteer. Have the student hold the end of his or her tongue while attempting to read the same passage. Discuss.

6. Ask students, "Do you know the song, 'All I Want For Christmas Is My Two Front Teeth?' Did you notice that the singer says "Chrithmuth?" Why do you think Christmas was pronounced that way?" Discuss.

7. Invite the speech teacher to answer any questions the children may have regarding the speech organs.

Extension

Research how people communicate when they have undergone surgical removal of the larynx because of disease.

GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Sense of Hearing
OUTCOME: 76. Describe parts of the ear and their functions in hearing.

Background

The three main parts of the ear are the outer ear, the middle ear, and the inner ear. The outer ear collects sound waves and sends them through a canal to the middle ear. A membrane called the eardrum is stretched across the end of the canal. High-pitched sounds cause the eardrum to vibrate faster, and loud sounds cause the eardrum to vibrate with more vigor or strength. These vibrations pass through the middle ear to the inner ear. There are three small bones in the middle ear which are joined to each other the hammer, the anvil, and the stirrup. The hammer connects with the eardrum and the stirrup, connects with the inner ear via a membrane called the oval window. When the hammer, anvil, and stirrup vibrate, they cause a vibration in the oval window. The hearing part of the inner ear is the cochlea, a spiral passage that is shaped like a snail's shell. The cochlea is filled with fluid. Its spiral passages are lined with thousands of tiny sensory hair cells. When the oval window vibrates, it makes vibrations inside the cochlea. The tiny nerve endings of the sensory hair cells sense these vibrations from the oval window and send the impulses to the auditory nerve. The auditory nerve transmits these nerve impulses to the brain where they are interpreted as sound.

Materials

- Model of ear obtained from scientific supply house
- Reference books with illustrations of the parts of the ear
- Pictures of the parts of the ear obtained from a doctor's office

For each student:
- Handout: HUMAN EAR

Procedures

1. Divide the class into groups of four.

2. Explain how the parts of the ear function in relation to hearing.

3. Make the reference materials available to each group.

4. Distribute the handout HUMAN EAR.

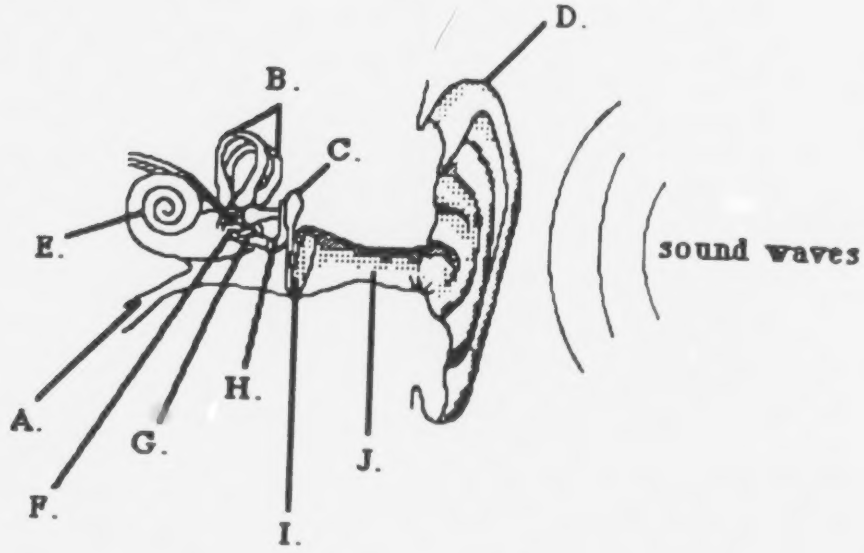
OUTCOME 76 (Continued)
Procedures (Continued)

5. Direct the students as they label the parts of the ear on the handout.

6. Ask members of each group to discuss among themselves how the parts of the ear function in the process of hearing. Have each group select a spokesperson to speak to the class about this information.

7. Display the papers on the bulletin board.

HUMAN EAR
Handout



The ear is divided into three main sections: the outer ear, the middle ear, and the inner ear. The outer ear includes the outer, visible part of the ear, the auditory canal, and the eardrum. The inner ear includes three small bones known as the hammer, the anvil, and the stirrup. The inner ear is made of an oval window, the cochlea, the auditory nerve, and the semicircular canals.

Look at the diagram of the ear and fill in the names of the parts on the form below.

Outer Ear

D.
I.
J.

Middle Ear

C.
G.
H.

Inner Ear

A.
B.
E.
F.

HUMAN EAR
Key

Outer Ear

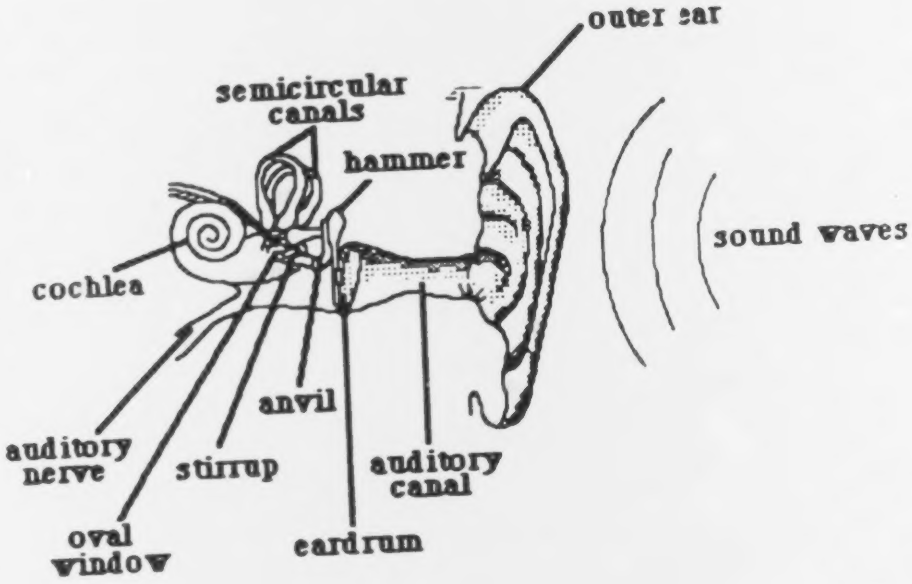
D. Outer ear (auricle)
I. Ear drum
J. Auditory canal

Middle Ear

C. Hammer
G. Stirrup
H. Anvil

Inner Ear

A. Auditory nerve
B. Semicircular canals
E. Cochlea
F. Oval Window


outer ear
semicircular canals
hammer
sound waves
cochlea
anvil
auditory nerve
stirrup
auditory canal
oval window
eardrum

GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Sense of Hearing
OUTCOME: 77. Explain ways of protecting the sense of hearing.

Background

The science of acoustics deals with sound and how it affects people. The field of environmental acoustics deals with control of noise pollution, a term heard increasingly. In this complex world, people are bombarded almost constantly by sound: the noises of appliances in homes, noise on construction sites, loud music, public address systems, jet planes, trains, big trucks, machinery, screaming and cheering for the ball team, and others. Much of this sound is detrimental to the sense of hearing, and it contributes to stress, fatigue, irritability, and elevated blood pressure. It may even shorten lives. Prolonged exposure to noise over 150 decibels can lead to immediate and permanent deafness. Rock bands, with their powerful amplifiers, produce music at the 120 decibel level.

Avoidance would seem the best solution to the problem of overexposure to noise, but that is a simplistic solution. People can avoid concerts where the music is too loud, and they can keep the stereo system at a low sound level at home; however, public awareness of the problem and community action toward a solution are needed to solve a problem which affects all people in complex communities. Public officials, acoustical engineers, operators of businesses, communities, and individuals all need to work together to find solutions to this pressing problem.

Materials

For each group:
- Ear plugs (one set)
- Alcohol
- Cotton balls
- Shoe boxes, identical (2)
- Scissors
- Foam rubber, 1" thick
- Glue
- Reference books
- Handout: SHOE BOX HOUSE

Procedures

1. Discuss the problems society faces with noise pollution.

OUTCOME 77 (Continued)
Procedures (Continued)

2. Assign students to groups of no more than four.
3. Distribute the handout SHOE BOX HOUSE, and have students follow the instructions given.
4. Have students take turns inserting and removing the ear plugs from their ears. Ask students to describe the effects of the plugs on hearing. CAUTION: After each use by a student, the ear plugs must be cleaned and sterilized by the use of alcohol-soaked cotton balls.
5. Discuss possible uses of ear plugs and insulation.
6. Have students research other ways of protecting the sense of hearing against loss. Provide an opportunity for reports to be given to the class.
7. Discuss the reports.

Extension

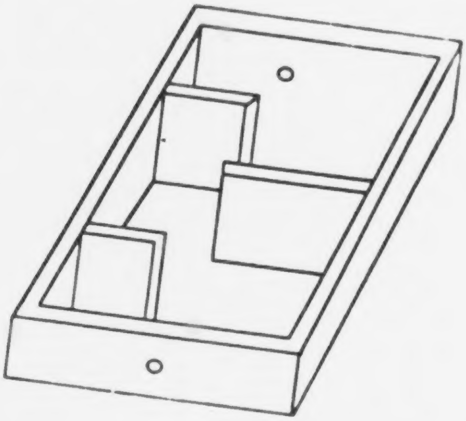
Encourage students to make other shoe box "houses," using different kinds of materials for insulation.

SHOE BOX HOUSE
Handout

1. Cut a round hole three inches in diameter in the ends of both boxes (four holes). Make the holes the same size in both boxes.

2. Cut foam rubber to line the sides, the top, and the bottom of one shoe box. Cut holes in the foam to match the holes in the boxes.

3. Measure and cut three pieces of foam rubber so that they fit from the bottom to the top of the shoe box and about halfway across (See drawing). Glue the foam pieces into place.



4. Place the lids on the boxes. One box is insulated with foam rubber; the other box is not insulated. Have your partner place his lips to one end of the box while you press your ear against the other end. Be sure that lips and ear are aligned with openings in the end of the boxes. Notice the volume of the sound. Now repeat the procedure with the box that is not insulated. What differences did you notice? Compare the sounds heard through the two boxes.

GRADE 5
PHYSICAL SCIENCE

UNIT: Sound and Energy
TOPIC: Sense of Hearing
OUTCOME: 78. Infer what would result if the sense of hearing were lost.

Background

The ability to hear and to speak clearly is very important. People of all ages, from infants to adults, may suffer varying degrees of hearing loss. Some are born deaf. Almost everyone loses some degree of hearing as they grow older. Although there are schools for the deaf and hearing aids for hearing-impaired persons, there is no perfect or completely satisfactory substitute for good hearing. Students should be made aware of the problems associated with hearing loss, and should be encouraged to take good care of their hearing.

The activity is divided into two parts. The first will help students understand that two ears enable one to locate the direction of sound. The second part will illustrate the difficulty that hearing-impaired persons have communicating over the telephone.

Materials

- Blindfold
- Ear plugs (one set per class)
- Alcohol
- Cotton balls
- Telephone, toy (2)
- Books about Helen Keller

Procedures

Part A

1. Explain that the lesson is about the sense of hearing and the result of hearing loss. Continue to move lips as if explaining the lesson, but do not make any sound. Watch the reaction of the students as they begin to understand what you are doing. Ask students to share their reactions.

2. Have a student sit in the center of the room. Place a blindfold over his or her eyes. Have another student strike two pencils together, moving from one location to another. Direct the blindfolded student to point in the direction of the sound each time the click is heard. Next, have the blindfolded student close one ear with a finger and point in the direction of the sound with the other hand. (Student should be able to tell the direction

OUTCOME 78 (Continued)
Procedures (Continued)

of the sound when both ears are open, but should have greater difficulty locating the direction of the sound when one ear is closed.) Ask all students to discuss how this experience applies to real-life situations.

Part B

1. Place two chairs back to back. Select two students to sit in the chairs and engage in a telephone conversation. Have one student place ear plugs in ears while trying to participate in the conversation. Ask the other student to initiate the conversation by speaking softly into the telephone. Does the other person respond? Now speak in a louder voice. Does he respond? If not, speak very loudly. What is his other response?

2. Ask students to think of ways in which deaf and hearing-impaired persons are restricted from activities that most of us take for granted. What special dangers do they face? What about employment opportunities? Are the deaf allowed to operate a motor vehicle? If a person has been deaf from his birth, how does he learn to speak? What is the quality of his speech?

Extensions

1. Demonstrate the Braille alphabet or display a poster on sign language.

2. Have a deaf student visit the class or someone that can speak in sign language.

3. Ask students to read books about Helen Keller for a book report or for a classroom presentation. Emphasize how serious handicaps can be overcome by strong, determined people.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Newton's Third Law
OUTCOME: 79. Explain Newton's Third Law.

Background

Isaac Newton stated that for every action there is an equal and opposite reaction. This activity allows the students to observe and describe the concept known as Newton's Law of Action and Reaction.

Materials

For each student:
- Balloon
- Marker
- Poster board (1/2 sheet)
- String, 5 in.
- Tape, 2 in.

Procedures

Part A. Experimenting and Investigating Newton's Third Law

1. Distribute a balloon, a marker, a string, and a piece of tape to each student. Instruct the students to tape the string to the side of the opening and to mark their initials on the balloon.

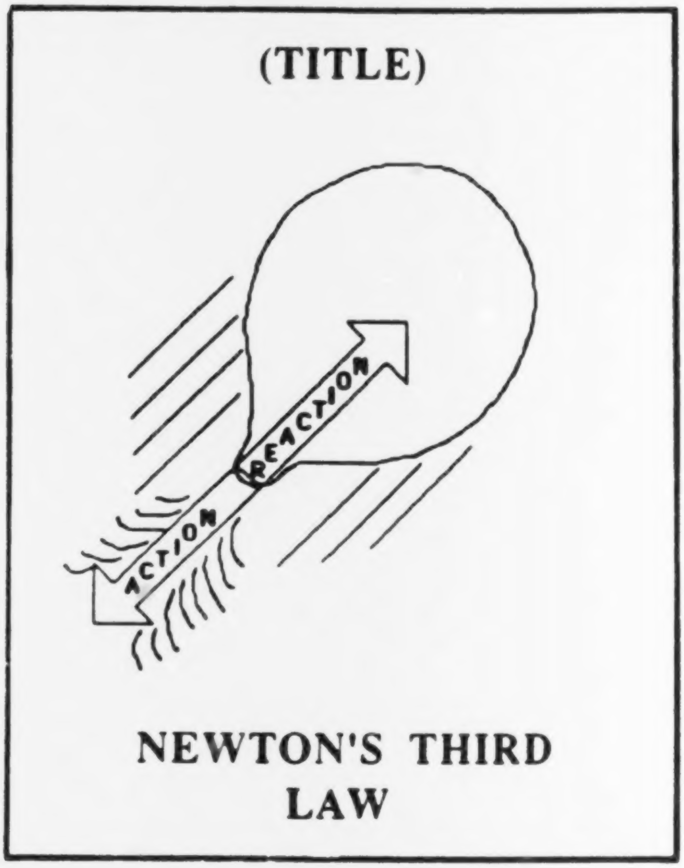
2. Direct the students to stand in a large circle facing the center. Have students inflate their balloons and hold them in one of their hands. Ask students to guess what direction they think the balloon will go when it is released. Instruct each student to observe what the balloon does when it is released. Ask students to extend the hand holding the balloon straight out toward the center. Direct students to release the balloons.

3. Have students explain what happened to the balloons and why they pushed away. Discuss with the students that the air pushes the balloon in one direction and the balloon pushes the air in another direction. State that the action of the balloon pushing the air results in a reaction of air pushing the balloon. Explain that this is known as Newton's Law of Action and Reaction.

OUTCOME 79 (Continued)
Procedures (Continued)

Part B. Drawing a Model of the Experiment

1. Distribute a sheet of poster board to each student. Have students draw a model of the balloon and use lines to show the direction of the balloon and the air after the balloon is released. Instruct the students to label the action and reaction, create a title, and state in their own words Newton's Third Law.



GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Electrical and Mechanical Energy
OUTCOME: 80. Explain a simple electrical circuit.

Background

Electricity is a form of energy that results from a flow of electrons. One type of electricity is current electricity. It is produced when electrons move from one place to another along a complete, unbroken path that is called a circuit. After a study on electricity, students, working in small groups, will design a model of a simple electrical circuit. Organize materials for each group into a plastic bag prior to the activity. Construct a large chart of a complete circuit for classroom display.

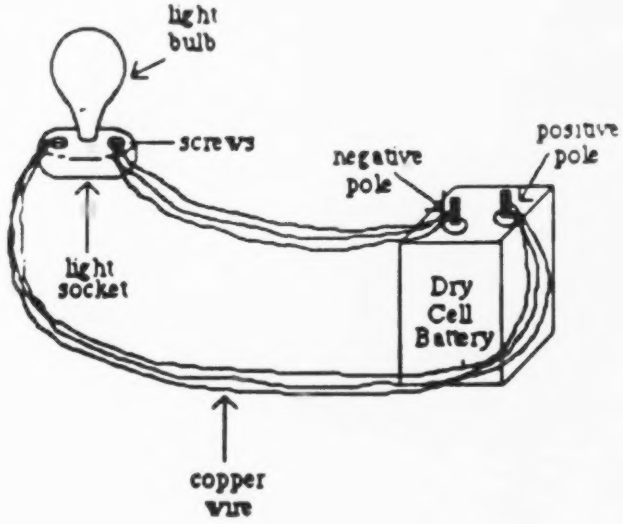
Materials

- Circuit drawing

For each group:
- Battery, dry-cell
- Copper wire, insulated, 10-in. single-strand (2)
- Light socket, small
- Bulb, flashlight
- Screwdriver

Procedures

1. Display a chart of a completed circuit. Discuss the various components of the circuit.



OUTCOME 80 (Continued)
Procedures (Continued)

2. Assign students to groups of no more than four and distribute materials to each group.

3. Have each group refer to the chart and build a circuit from their materials. Remind students to screw the bulb tightly into the socket and attach the wires securely under the screws on the sides of the light socket.

4. Discuss with the students that the bulb illuminates because the flow of electrons from the negative pole of the battery traveled through the copper wire to the light and back to the positive pole on the battery.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Electrical and Mechanical Energy
OUTCOME: 81. Discover uses of electrical energy.

Background

There are many uses of electrical energy. The production of heat is one use of electrical energy. Appliances such as irons, coffee percolators, water heaters, and blankets all have conductors that get hot when an electric current flows through them. Another use of electrical energy is the production of light. When much resistance is created in the filament of a light bulb, the filament becomes hot enough to transmit a bright light. Electricity can be used to run a motor. Electrical energy is changed to mechanical energy in a motor. Electricity can also be used to plate metals. This process is called electroplating. Some examples of this would be plating silverware and putting chromium on bumpers, grills, and automobiles.

Materials

- Lamp
- Toaster
- Mixer
- Plated silverware

For each group:
- Magazines
- Scissors
- Glue
- Poster board

Procedures

Part A. Identifying and discussing the various uses of electrical energy

1. Display a lamp, toaster, mixer, and plated silverware.

2. Have students infer how electrical energy is used with these various household items. List all responses on the board. Encourage responses from all students. After listing the responses on the board, explain how each item uses electrical energy.

OUTCOME 81 (Continued)
Procedures (Continued)

Part B. Making a collage

1. Divide students into four different groups and give each group glue, scissors, magazines, and a poster board. Assign each group a different use of electrical energy. Include the following uses: heat, light, mechanical and electroplating.
2. Have students cut out examples of the type of electrical energy chosen. Display an example of a collage and have students work as a group to create their "Electrical Energy Collage."
3. Display collages on classroom bulletin board.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Electrical and Mechanical Energy
OUTCOME: 81. Discover the uses of electrical energy.

Background

One type of energy used in many homes and factories is produced by current electricity. This type of energy is called electrical energy, which is carried from one place to another through wires.

Electrical energy can be used to make an electromagnet. An electromagnet is formed when a current is passed through a wire coiled around a metal core.

Electrical energy can be changed into mechanical energy. Mechanical energy is the energy used in moving parts of a machine, such as an electric mixer.

Electrical energy is also a source of heat and light energy, such as an electric heater and a light bulb in a lamp. Teachers and students should be constantly alert to safety precautions while working with electricity.

PRECAUTIONS

a. Students should be told not to experiment with any electrical current.

b. Electrical cords should be short and in good condition.

c. Students' hands should be dry when touching electrical cords, switches, or appliances.

d. Students should avoid contact with any moving parts of an appliance.

e. Students should avoid contact with any heating element of an appliance.

f. When removing an electrical plug from a wall outlet, students should pull the plug and not the cord.

Materials

- Copper wire, 22 gauge insulated, stripped on both ends, 1 mm
- Battery, dry-cell (1 1/2 volt)
- Iron nail, large, no longer than 10 cm
- Paper clips (5)

OUTCOME 81 (Continued)

Materials (Continued)

- Electric clock (or other small motor appliance) with motor exposed
- Electric toaster
- Slices of bread (8-10)
- Electric lamp
- Electrical outlet
- LABORATORY CARD - Station 1: Electromagnet
- LABORATORY CARD - Station 2: Lamp
- LABORATORY CARD - Station 3: Toaster
- LABORATORY CARD - Station 4: Clock (or other small motor appliance)

Procedures

1. Discuss the various uses of electrical energy.

2. Divide the class into four groups.

3. Direct each group to a separate laboratory station.
   Station 1: Electromagnet
   Station 2: Lamp
   Station 3: Toaster
   Station 4: Electric clock

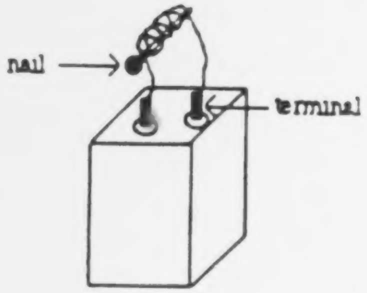
4. Tell students to read the laboratory card at the assigned station and follow the directions.

5. Tell students to observe the type of energy being used in each station and into what form it has been changed.

6. Direct students to answer the questions on each card in their science notebooks.

7. Explain that a group is to spend ten minutes in a station; then, move to another station.

LABORATORY CARD
Station 1: Electromagnet



Materials

- Copper wire
- Dry-cell battery
- Iron nail
- Paper clips

Procedures

1. Coil the wire around the nail ten times.
2. Attach one end of the wire to one terminal of the battery.
3. Touch the other end of the wire to the other terminal of the battery.
4. Hold some paper clips in the palm of one hand and move the the hand close to the nail.

Results (Write in science notebook.)

a. What happened?

b. What caused this?

LABORATORY CARD
Station 2: Lamp

Materials

- Lamp
- Electrical outlet

Procedure

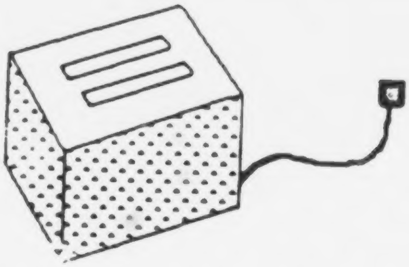
Plug the lamp into the outlet.

Results (Write in science notebook)

a. What type of energy caused the lamp to light?

b. What type of energy is being produced by the light?

LABORATORY CARD
Station 3: Toaster



Materials

- Electric toaster
- Electrical outlet
- Slices of bread

Procedures

1. Plug the cord of the toaster into the outlet.
2. Insert slices of bread into toaster.
3. Observe what happens to the bread.

Results (Write in science notebook)

a. What type of energy caused the toaster to work?

b. What happened to the inside of the toaster?

c. What happened to the bread?

d. What type of energy was produced?

LABORATORY CARD
Station 4: Clock

Materials

- Electric clock with motor exposed
- Electrical outlet

Procedure

Plug the cord into the outlet. (Do not touch the motor.)

Results (Write in science notebook)

a. What happens inside the clock?

b. What type of energy caused the clock to work?

c. What type of energy is being produced?

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Electrical and Mechanical Energy
OUTCOME: 82. Discover the uses of mechanical energy.

Background

Mechanical energy is energy produced by moving machine parts. An electric motor changes electrical energy into mechanical energy. When an electrical appliance is plugged into a wall outlet, the electricity turns the motor, thus creating mechanical energy.
After a discussion of mechanical energy, students will identify different uses of it.

Materials

For each group:
- Magazines
- Poster board
- Markers
- Ruler
- Scissors
- Glue

Procedures

1. Divide the class into groups of three.

2. Give each group magazines, poster board, markers, a ruler, scissors, and glue.

3. Direct the students to look through the magazines and cut out pictures of household appliances that illustrate how electrical energy is changed into mechanical energy.

4. Ask each group of students to draw a cutaway view of a house on the piece of poster board, identifying specific rooms.

5. Direct the students to attach their pictures to the specific rooms in which the appliance would be appropriate.

6. Encourage students to draw appliances if pictures cannot be found for all they can identify.

7. Display the posters and discuss the results.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy.
TOPIC: Electrical and Mechanical Energy
OUTCOME: 83. Identify an example of electrical energy changed to mechanical energy.

Background

When electrical energy is passed through a wire, there is a magnetic field around the wire. If the wire is coiled around a bar of soft iron, a magnet is created. This electromagnet causes mechanical energy or energy of movement in such devices as a telephone, a radio, a motor, a generator, bells, buzzers, and electric appliances. After a discussion of how electrical energy can be changed to mechanical energy, students will make a simple telegraph set. NOTE: The telegraph set can also be used in the Contributions and Careers in Science (Outcomes 90, 91, 92).

Materials

For each group:
- Wood, flat, 10 x 20 cm
- Blocks, wood, 15 x 10 cm (2)
- Nails, steel (5)
- Nail, aluminum
- Thumbtacks, metal
- T-shaped piece of tin, may be cut from a can if sides are filed
- Wire, insulated
- Thin strip of metal: brass, copper, or tin
- Battery, dry cell, number 6
- Hammer
- Strippers, wire
- Laboratory Card: DIRECTIONS FOR MAKING A TELEGRAPH

Procedures

1. Divide the class into groups of no more than four students each.

2. Distribute the materials to each group.

3. Instruct students to follow directions on the laboratory card to prepare their telegraph.

DIRECTIONS FOR MAKING A TELEGRAPH
Laboratory Card

1. Nail together the wood base and one of the small wood blocks. Use two nails.

2. Nail the T to the small wood block.

3. Hammer two steel nails about three centimeters apart on one end of the base opposite the small wood block and the T strip.

4. Wrap a piece of insulated wire around the nails to form coils. (About 30 turns for each nail) Leave 25-30 centimeters of wire free on both ends.

5. Connect one wire end to the DRY CELL (remove the plastic covering from the wire). Leave the other wire end loose to connect to the sounder.

6. Hammer a bent aluminum nail next to, but not touching, the T-shaped piece of tin between the two coils.

7. Attach the thin metal strip to the other small wooden block by pushing two of the thumb tacks through the key and halfway into the wooden block.

8. Remove the plastic covering from the free end of the wire. Wrap it around the thumb tacks on the key.

9. Bend the metal strip upward.

10. Push a thumb tack into the wood under the metal strip.

11. Remove the plastic coating from both ends of another piece of insulated wire.

12. Attach one end of the wire to the tack under the metal strip. Attach the other end to the dry cell.

13. Your TELEGRAPH is now ready to use.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Magnetism
OUTCOME: 84. Explore uses of magnets.

Background

There are many types of magnets. Natural magnets called lodestones are found in the ground. Man-made magnets are made from nickel, steel, cobalt, and iron. These magnets are able to attract materials made of iron, steel, cobalt, or nickel.

Magnets can be used to keep doors closed, to remove lids from cans with a can opener, in electric motors, in generators, in compasses, and in many games and toys.

A compass needle uses a small magnet. The north seeks end points north and the south seeks end points south. If a bar magnet's north end is brought near the north seeking pole the compass needle will repel, but the south seeking pole will be attracted.

Materials

For each group:
- Stopper, cork, 1/2 inch thick
- Sewing needle, steel
- Dish, glass
- Water (1 quart)
- Magnet, bar
- Spoon
- Handout: LABORATORY CARD

Procedures

1. After discussing the uses of a magnet, divide the students into groups of no more than four. Distribute to each group the handout LABORATORY CARD on how to make a compass.

2. Direct the students to read the laboratory cards, follow the directions, and answer the questions in their notebooks.

3. After the students have completed the experiment, discuss the questions and answers on the laboratory card.

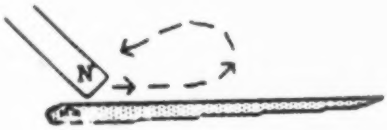
LABORATORY CARD
Handout

Materials

- Cork stopper
- Steel sewing needle
- Glass dish filled with water (1 teaspoon of detergent in the water)
- Bar magnet
- Spoon

Procedures

1. Magnetize the needle by stroking one end of the bar magnet against the needle. Do this slowly about forty times in one direction.



2. Fill the dish to about three-fourths of its capacity. Pour into the water one teaspoon of detergent. Hypothesize why the detergent is needed.

3. What do you observe is happening to the needle?

4. Why did the needle move in that direction?

5. Why would a compass be important to have if you were hiking in the woods?

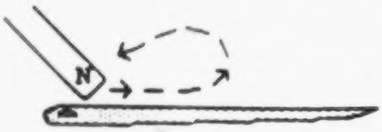
LABORATORY CARD
Key

Materials

- Cork stopper
- Steel sewing needle
- Glass dish filled with water (1 teaspoon of detergent in the water)
- Bar magnet
- Spoon

Procedures

1. Magnetize the needle by stroking one end of the bar magnet against the needle. Do this slowly about forty times in one direction.



2. Fill the dish to about three-fourths of its capacity. Pour into the water one teaspoon of detergent. Ask students to hypothesize why the detergent is needed.

   (Detergent will decrease friction in the water.)

3. What do you observe is happening to the needle?

   (Answers may vary.)

4. Why did the needle move in that direction?

   (Answers may vary.)

5. Why would a compass be important to have if you were hiking in the woods?

   (to provide direction so one would not get lost)

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Magnetism
OUTCOME: 85. Explain how a magnet works.

Background

No one knows exactly when men discovered that a certain type of iron ore would attract other rocks, but the Greeks described the strange behavior of magnetite about 2,500 years ago. Magnets strongly attract objects made of iron and steel. Magnets also have an attraction for a few other metals such as nickel and cobalt; however, the attraction is very weak and not generally observed. It is now thought that almost all substances are influenced to some degree by magnets, but only iron and steel are strongly attracted.

When a magnet is broken into two parts, each part becomes a complete magnet. If the magnet were divided in half until it reached the size of a single iron atom, it is assumed that each atom of iron would be a magnet. This assumption forms the basis for the currently accepted theory of magnetism.

Scientists are not certain why the atoms of iron, nickel, and cobalt act as tiny magnets. Evidence seems to indicate that the magnetic field of these atoms is caused by the rotation of each electron around its own axis.

The elements that have strong magnetization are called ferromagnetic metal. A sample of a ferromagnetic metal is composed of regions in which the force fields of the magnet atoms are all pointed in the same direction. These regions, called ferromagnetic domains, will normally be arranged so that their magnetic fields cancel each other.

Materials

- Overhead projector
- Iron shavings
- Magnet, bar
- Magnet, horseshoe
- Magnet, circular

Procedures

1. Discuss the properties of magnets and how they work.

2. Place one bar magnet on the overhead projector and have students predict what would happen if iron shavings were close to it.

OUTCOME 85 (Continued)
Procedures (Continued)

3. Sprinkle iron shavings over the magnet and have students observe where the shavings have collected.

4. Have a student place the horseshoe magnet on the stage of the overhead projector, sprinkle iron shavings over the magnet, and compare the different magnetic fields.

5. Place a circular magnet (used mainly in electronic computers) on the overhead projector. Repeat the process. Direct the students' attention to the different magnetic fields.

6. Repeat the process. Have the students draw the three different magnetic fields on paper as each step is repeated.

7. Discuss the different patterns.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Magnetism
OUTCOME: 86. Discover the difference between bar magnets and electromagnets.

Background

The best known magnets, bar magnets, are pieces of metal that attract some other kinds of metal. Bar magnets have both north and south poles. The magnetism is strongest at the poles or ends of the magnet. Bar magnets are considered permanent magnets because they maintain their magnetism over an indefinite period of time, if handled properly. Most bar magnets are made of a mixture of nickel, iron, cobalt, and other substances. When an electric current flows through a wire that is wrapped around a metal object, it becomes an electromagnet. Once the current is disconnected, the metal is no longer magnetized.

Materials

- Magnets, bar (2)
- Battery, dry-cell, 6-volt
- Wire, insulated, 4
- Nail, 5-in.
- Paper clips (5)
- Compass
- String

Procedures

1. Display two bar magnets so that the class can observe them. Discuss the differences between the properties and magnetic fields of magnets. Remind students that a magnetic field is the area around a magnet where its magnetic force can be experienced. Emphasize that magnetism is permanent in bar magnets.

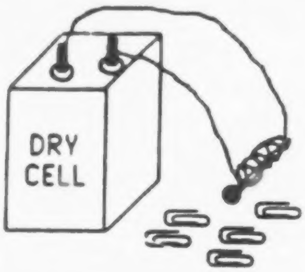
2. Ask students to attract different objects with one of the magnets to show how objects become temporarily magnetized.

3. Hold a bar magnet by a string tied around its center. Place a compass under the magnet and have the students observe how one end will point north and the other end will point south. Switch positions and have the students predict which direction the north end of the bar magnet will point. Explain that the north and south poles of the magnet point as they do because the earth's magnetic poles are near the north and south geographic poles.

OUTCOME 86 (Continued)
Procedures (Continued)

4. Assign students to groups of no more than four. Have students hold two bar magnets with the north poles together. Point out that the two north poles repel. Tell students to place the south pole and the north pole together. Direct students' attention to the attraction of the opposite poles.

5. Assign no more than three students to construct an electromagnet using a dry-cell battery. Have the students wrap the wire around the nail twenty times and attach each end of the wire to a terminal on the battery. (See illustration.)



6. Have the students predict what will happen to the nail when the current passes through it.

7. Have the students predict what will happen to the nail when the number of coils is increased.

8. Select two other students to demonstrate that the electromagnet now has a magnetic field. (Use the paper clips to show how the electromagnet attracts the metal.)

9. Remove one wire from the terminal and have the students tell what will happen to the magnetic attraction.

10. Wrap the nail forty times with the wire. Have students observe the number of paper clips the electromagnet attracts. Compare the strength of the magnetic fields in steps five and six.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Heat Energy
OUTCOME: 87. Explain heat energy.

Background

Heat energy is produced by constantly moving molecules. Every substance is composed of molecules, some moving very fast and some moving slowly. The faster the molecules move, the hotter the substance becomes. Conversely, the slower the molecules move, the cooler the substance becomes. The motion of the rapidly moving molecules produces heat, and heat is energy of motion or moving molecules. Heat energy can be produced by mechanical energy, chemical energy, electrical energy, radiant energy, and nuclear energy. Heat energy travels in one of three ways: by conduction, by convection, and by radiation. Heat energy is measured by a thermometer.

Preparation for this activity will require a method for heating water. Caution students about safety procedures needed when working with heat.

Materials

For each group:
- Pyrex container of hot water (12 oz.)
- Container of cold water (12 oz.)
- Food coloring, blue (1 bottle)
- Dropper, medicine
- Candle
- Matches
- Foil, 6" x 6"
- Rod, copper, 1/4 " diameter
- Small balls of sealing wax or candle wax (3)
- Goggles

Procedures

1. Discuss with the students the information on heat energy contained in the Background.

2. Explain to the students that the rapidly moving molecules produce an energy called kinetic energy. Tell students that heat is produced when the kinetic energy is accelerated by rapidly moving molecules.

3. Divide class into groups of four and distribute the containers of hot and cold water, blue food coloring, and a medicine dropper to each group.

OUTCOME 87 (Continued)

Procedures (Continued)

4. Tell students to label their notebook papers "Cold Water" and "Hot Water."

5. Instruct students to observe the containers carefully and write their observations on their notebook papers.

6. Direct students to place four drops of blue food coloring in each container and begin their observation.

7. After five minutes of observation time, ask students to discuss the observations recorded under each heading "Hot Water" and "Cold Water."

8. Ask the students why the blue food coloring dispersed faster in the hot water than in the cold water. (The molecules in the hot water are moving faster and have more kinetic energy than the molecules in cold water; therefore, the molecules in hot water disperse the blue food coloring faster than the slower cold molecules.)

9. Discuss with the students the different ways heat energy is produced. Write them on the chalkboard.

a.	Mechanical Energy	Friction, compression, percussion
b.	Chemical Energy	Burning of fuels, oil, coal, wood, gas
c.	Electrical Energy	Electric current
d.	Radiant Energy	Sun (Radiant Energy Waves)
e.	Nuclear Energy	Atomic energy produced by splitting atoms

10. Ask students to cite examples of each type of heat energy listed.

11. Review with the students the three ways in which heat energy travels: by conduction, by convection, and by radiation.

12. Distribute a candle, matches, foil, a copper rod, wax, and goggles to each group for the next activity.

13. Tell students this activity will demonstrate how heat energy travels by conduction.

OUTCOME 87 (Continued)
Procedures (Continued)

14. Instruct students to melt a small amount of wax on the aluminum foil squares and to place their candles on the foil. Have students to light their candles. (Remind students that the burning match is an example of chemical energy.)

15. Caution students about safety procedures when using heat. Have them put on goggles.

16. Direct students to place three pieces of wax at equal intervals along the copper rod.

17. Tell students to hold the copper rod over the flame (not in the flame) and observe what happens to the wax. Caution the students NOT to touch the rod beyond the handle.

18. Ask students to draw a picture of what happened on their notebook papers and to write their observations.

19. Direct students to write an explanation about what happened to the wax.

20. Ask students to discuss their explanations.

21. Explain to the students that the molecules in the copper rod next to the heat source began moving very rapidly; then they bumped into other molecules which in turn began a rapid movement and struck other molecules. Tell students that molecules produced a faster movement or kinetic energy and progressed through the copper rod, conducting heat energy as demonstrated by the melting wax.

22. Review heat energy with the students, stressing the experiments and discussing the other forms of heat energy.

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Heat Energy
OUTCOME: 88. Identify materials that are conductors and nonconductors of energy.

Background

Conduction is the flow of heat due to the transfer of energy from one particle (molecule) striking another. Metals conduct heat better than wood, paper, or plastic foam. Poor conductors are called insulators. Air is the poorest conductor.

Materials

- Spoon, stainless steel
- Spoon, silver
- Spoon, plastic
- Spoon, wooden
- Rod, glass
- Margarine or butter, solid
- Peas, dried
- Glass of boiling water
- Handout: CONDUCTORS AND NONCONDUCTORS

Procedures

1. Distribute the handout CONDUCTORS AND NONCONDUCTORS.

2. Direct students to place a small amount of margarine on the handle of the silver and the steel spoons and the glass rod. Place the small amount of margarine at the same position on the spoon and the glass rod. Place a pea in the center of each dab of margarine on each spoon and the glass rod.

3. Place the spoons and the glass rod in an empty glass.

4. Pour boiling water in the glass.

5. Have students record the time order in which the peas fall--first, second, and so on. (The order will be the silver spoon, the steel spoon, and then the glass rod. The wooden spoon and the plastic spoon will be last. This activity shows that silver is the best conductor of heat and that plastic is the poorest. This is the reason many saucepans and skillets have plastic and wooden handles.)

6. Have students complete the handout CONDUCTORS AND NONCONDUCTORS. (Students may want to predict the order in which the dabs of margarine melt before the hot water is poured into the glass. They can then check the actual times against their predictions. See the handout.)

7. Discuss the results.

CONDUCTORS AND NONCONDUCTORS
Handout

MATERIALS	TIME PREDICTION	ACTUAL TIME	CONDUCTOR	NON-CONDUCTOR
Silver spoon				
Steel spoon				
Glass rod				
Wooden spoon				
Plastic spoon				

Fill in the chart and answer these questions.

1. Which metal is the best conductor of heat energy?
2. Which material is the poorest conductor?
3. Put an (X) under either conductor or nonconductor for each material.
4. Can you think of any material that could be used to keep heat from getting to your cold materials such as ice and ice cream?

GRADE 5
PHYSICAL SCIENCE

UNIT: Production, Consumption, and Conservation of Energy
TOPIC: Heat Energy
OUTCOME: 89. Discover substances which do and do not conduct heat.

Background

Most metals are good conductors of heat. Silver is a superior conductor of heat. Most nonmetal materials, gases, and liquids are poor conductors of heat. When a metal object is heated, the molecules closest to the source of heat begin to move and collide with surrounding molecules. The faster the molecules move in the heated material, the greater the kinetic energy of the molecules, and the hotter the material. In materials that conduct heat poorly, the molecules have more space between them and do not collide as often as they do in materials where the molecules are more tightly packed; therefore, less heat is generated. Heat cannot be conducted in a vacuum because there are no molecules to be set into motion.

This activity will help students understand that metals are better conductors of heat than are nonmetal materials.

This activity must be conducted with great care due to the potential for injury. Do not allow a student to heat or pour hot water. Repeat these procedures as many times as desired in order to involve the class. Heat the water so that it is very hot, but is not boiling.

Materials

- Hot plate
- Pot
- Water, hot
- Mug, ceramic or glass
- Plastic mug with lid, double-wall construction
- Teaspoon, metal
- Teaspoon, plastic
- Glass jar with metal lid
- Towel rods or sticks, 12" (10)
- Newspaper
- String, cotton
- Straws, plastic (2)

Procedures

1. Place one metal spoon and one plastic spoon in a ceramic mug. Pour hot water into the cup until it is two-thirds full. Have a student grasp the very ends of both spoons. Ask the student to release the spoon that becomes uncomfortably warm. Ask the student which material conducted heat the faster.

OUTCOME 89 (Continued)
Procedures (Continued)

2. Fill the double-walled plastic mug with very hot water. Cover it with the lid. Have a student place his or her hands around the mug for at least one minute. Ask him or her to describe what he or she felt.

3. Wrap a glass jar with several layers of newspaper. Tie the paper tightly with the cotton string. Pour hot water into the jar and place the metal lid on tight enough to keep water from spilling. Ask for a volunteer to touch the lid and then release it quickly. Ask the student to describe what he or she felt. Ask the same student to place both hands on the outside of the jar which has a newspaper insulation. Ask him or her to compare the heat in the metal lid with the heat in the paper around the jar.

4. Give five students two towel rods or sticks each. Ask them to rub the two sticks together until they can feel some warmth at the site of the friction. How long did it take for the heat to build? Did the heat extend along the length of the sticks, or was it confined to the area where the sticks rubbed together? Then, have students rub two plastic straws together. Compare the results with the sticks.

5. Ask students to draw conclusions about the best and the poorest conductors of heat.

GRADE 5
CONTRIBUTIONS AND CAREERS IN THE FIELDS OF LIFE SCIENCES, EARTH SCIENCES AND PHYSICAL SCIENCES

UNIT: Contributions and Careers in Science
TOPIC: Contributions of Scientists
OUTCOMES: 90. Identify men and women who have contributed to the fields of Life Science, Earth Science, and Physical Science.

91. Describe what men and women have done in the fields of Life Science, Earth Science, and Physical Science.

92. Explain why an understanding of Life Sciences, Earth Sciences, and Physical Sciences can contribute to the quality of life in today's and tomorrow's societies.

TOPIC: Career Opportunities
OUTCOMES: 93. Identify careers related to an understanding of the Life Sciences, Earth Sciences, and Physical Sciences.

94. Explain how careers depend on a basic understanding of Life Sciences, Earth Sciences, and Physical Sciences.

Background

The goal of science education should be to develop scientific literacy through a balanced science curriculum that prepares students to pursue further studies in science and technology, participate in a technological society of informed citizens, enter the modern work world, and develop intellectually and morally to their fullest. ("The New Basic in Education: Sciencing" taken from an interview given by Dr. Gerald Krockover, Professor of Geosciences and Education, Purdue University.)

Building more realistic images of scientists may help students become interested in science as career choices. The stereotypical image of a scientist as a man in a white lab coat must be broadened. A scientist may be a parent, a neighbor, or a teacher. In short, a scientist is anyone who studies a problem using the scientific method of research in gathering data, conducting experiments, making observations, and testing results.

Biographical data on scientists and activities that address contributions and careers in the fields of Life Science, Earth Science, and Physical Science are included in this section of the curriculum guide. Biographical data may be expanded to include many other scientists. The information about each scientist may be stored in a biographical data file.

OUTCOMES 90, 91, 92, 93, and 94 (Continued)

Background (Continued)

The following procedures describe how to construct a biographical data file.

Materials

- Shoe box
- Paper, adhesive-backed
- Index cards, 5" x 8"
- Tabs or markers
- Biographical Data: GRANVILLE T. WOODS
- Biographical Data: MERLIN TUTTLE
- Biographical Data: ALEXANDER HUMBOLDT
- Biographical Data: MARK AND DELIA OWENS

Procedures

1. Make a biographical data file of famous scientists.

2. Transfer the biographical data onto 5- by 8-inch index cards.

3. Separate the index cards into three categories: Life Sciences, Earth Sciences, and Physical Sciences.

4. Use tabs to indicate category separations or use markers to color-code corners of the index cards. (Life Sciences--red, Earth Sciences--blue, Physical Sciences--green)

5. Cover a shoe box with colorful adhesive-backed paper.

6. Use the shoe box as a container for the biographical data cards.

7. Use the biographical data file with each activity concerning the contributions and careers of scientists.

GRANVILLE T. WOODS (1856-1910)
Biographical Data

Granville T. Woods was a Black-American inventor who obtained more than fifty patents. He made his most significant invention, a railway telegraph system, in 1887. This system allowed crew members on moving trains to communicate with one another and with railroad stations. It made rail traffic safer by helping to avoid train collisions.

Woods was born in Columbus, Ohio. He was mostly self-taught, but also took college engineering courses and worked as a railroad engineer. Woods received his first patent for an improved steam boiler furnace in 1884. His inventions included an egg incubator, an automatic air brake, a galvanic (electric) battery, a telephone transmitter, and devices for telegraphs and railway systems. Woods sold many inventions to large companies such as General Electric, Westinghouse Air Brake, and American Bell Telephone.

MERLINE TUTTLE
Biographical Data

Dr. Merlin Tuttle is a leading expert on bats or a Chiroptologist. Dr. Tuttle has devoted his life to educating the public about bats, and is the founder and science director of Bat Conservation International in Austin, Texas. His outstanding photographs of bats have appeared in books and National Geographic magazines.

Dr. Tuttle is a world renowned bat researcher and photographer. He has provided much needed information about bats and dispelled many myths associated with them. His most recently published book is America's Neighborhood Bats, University of Texas Press, Austin, 1988.

ALEXANDER VON HUMBOLDT (1769-1859)
Biographical Data

German scientist and geographer Humboldt studied ocean currents, volcanoes, waterways, and the earth's magnetism. He collected over 60,000 plants. At the age of twenty-five, Humboldt was left with an inheritance which allowed him to spend the rest of his life in enthusiastic research and travel, earning him the title Founder of Geographics.

MARK AND DELIA OWENS
Biographical Data

In 1974, two students met in a protozoology class at the University of Georgia. They later caught a plane to Africa, bought a third-hand Land Rover, and drove into the Kalahari Desert. They carried with them two backpacks, two sleeping bags, one pup tent, a small cook kit, a camera, clothes, and $6,000.00

The people are Mark and Delia Owens, wildlife authors of Cry of the Kalahari. While at the University of Georgia, Mark and Delia heard a visiting scientist tell of Africa's disappearing wilderness. They became determined to study an African carnivore in a large, pristine wilderness and to use the results of their research to devise a program of conservation of that ecosystem.

They lived on the Kalahari Desert for seven years in an unexplored area with no roads, no people, and no source of water for thousands of miles. In this wilderness they met animals that had never seen humans before. They would wake in the mornings to find lions sleeping beside them; leopards, giraffes, and brown hyenas were regular visitors to the camp. Mark and Delia were continually confronted with danger from droughts, fire, storms, and even from the animals they loved.

Mark and Delia Owen completed their graduate work at the University of California at Davis. They also completed their research on the conservation of Kalahari lions, brown hyenas, and migratory Kalahari ungulates. Because of their book and published research data, public awareness has increased concerning the plight of African animals.

OUTCOMES 90, 91, 92, 93, and 94 (Continued)

Background

In the following activity, students in groups of four will build a simple telegraph. It will be necessary to reproduce the directions for making the telegraph on a LAB CARD for each group.

The T-shaped piece of tin, required to make the armature in the telegraph, may be cut from a metal can with tin snips prior to the activity. The edges of the can must be filed before use.

A simple telegraph has four parts: a source of electricity such as a dry cell, a key that acts like a switch to turn the current on and off, a wire that connects the parts of the circuit together, and a sounder that receives the electrical energy and converts it to sound. The sounder has two parts, an electromagnet and an armature.

When the key is pressed down, a current flows through the circuit, and the electromagnet becomes magnetized. The electromagnet attracts the armature, which hits the metal nails below it and makes a clicking noise. When the key is released, the electric current stops flowing, and the electromagnet loses it magnetism.

The armature is no longer attracted and springs back into position. When the armature springs back, it hits the bent metal nail above it, making a clicking noise. By pressing the key for a longer or shorter amount of time, the time between the clicks that are produced can be controlled. If the time between the clicks is short, and two clicks come close together, a dot is made. Two clicks far apart is called a dash. This system of dots and dashes is called the Morse Code.

OUTCOMES 90, 91, 92, 93, and 94 (Continued)

Materials

- Biographical Data: GRANVILLE T. WOODS

For each group:
- Wood, flat, 10 x 20 cm
- Blocks, wood, 15 x 10 cm (2)
- Nails, steel (5)
- Nail, aluminum
- Thumbtacks, metal
- T-shaped piece of tin, may be cut from a can if sides are filed
- Wire, insulated
- Thin strip of metal: brass, copper, or tin
- Battery, dry cell, number 6
- Hammer
- Strippers, wire
- Laboratory Card: DIRECTIONS FOR MAKING A TELEGRAPH

Procedures

1. Discuss with students information about Granville T. Woods.

2. Divide the class into groups of no more than four students each.

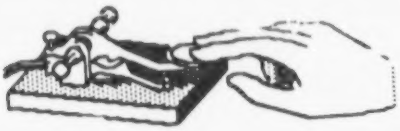
3. Distribute the materials to each group.

4. Instruct students to follow directions on the LAB CARD in preparation of their telegraph.

5. Discuss with students how the telegraph system was helpful, especially in train travel.

DIRECTIONS FOR MAKING A TELEGRAPH
Laboratory Card

1. Nail together the wood base and one of the small wood blocks. Use two nails.
2. Nail the T to the small wood block.
3. Hammer two steel nails about three centimeters apart on one end of the base opposite the small wood block and the T strip.
4. Wrap a piece of insulated wire around the nails to form coils. (About 30 turns for each nail) Leave 25-30 centimeters of wire free on both ends.
5. Connect one wire end to the DRY CELL (remove the plastic covering from the wire). Leave the other wire end loose to connect to the sounder.
6. Hammer a bent aluminum nail next to, but not touching, the T-shaped piece of tin between the two coils.
7. Attach the thin metal strip to the other small wooden block by pushing two of the thumb tacks through the key and halfway into the wooden block.
8. Remove the plastic covering from the free end of the wire. Wrap it around the thumb tacks on the key.
9. Bend the metal strip upward.
10. Push a thumb tack into the wood under the metal strip.
11. Remove the plastic coating from both ends of another piece of insulated wire.
12. Attach one end of the wire to the tack under the metal strip. Attach the other end to the dry cell.
13. Your TELEGRAPH is now ready to use.



OUTCOMES 90, 91, 92, 93, and 94 (Continued)

Background

A bat expert is a chiroptologist. Dr. Merlin Tuttle is an internationally known chiroptologist. He has dedicated his life to public education about bats.

Bats are truly the only flying mammals. The bones in a bat's wing are essentially the same as those in human arms and hands. The name of the scientific order for bats, Chiroptera, means hand wing.

Throughout the world's tropics, fruit-eating bats are nature's most important seed-dispersing animals, and nectar bats are essential for the pollination of countless tropical and subtropical trees and shrubs. If it were not for bats, people may never have had peaches, bananas, bread, fruit, mangoes, guavas, figs, avocadoes, cashews, cloves, chicle latex for chewing gum, balsa wood, manila and sisal fibers for rope, and kapok for bandages and life preservers. Bat guano (droppings) is still a valuable source of fertilizer. The loss of bats could seriously threaten the survival of tropical rain forests, which are vital to maintaining our climate worldwide.

In the United States, there are thirty-nine species of bats. Almost all of them are working conscientiously to control the mosquito and other members of the flying insect population. During flight, bats emit high-pitched sounds and listen for the echo, thus homing in on flying insects (echolocation). The gray bat of the United States can catch and consume as many as 3,000 insects per night.

Throughout the world, there are some 1,000 species of bats. About 70 percent of them are insectivorous. The big fruit bats, or flying foxes, do not have sonar. Some of them have wingspans up to six feet. The tiniest mammal of all is a bat about the size of a bumble bee.

About one-third of one percent of bats are vampire bats. All of them are in Latin America. They are a nuisance to cattle owners, but they are nothing at all like "Count Dracula."

OUTCOMES 90, 91, 92, 93, and 94 (Continued)
Background (Continued)

Many popular notions about bats are not factual. Bats are not flying "rodents" nor are they vicious or dirty. Bats are not blind; in fact, they see quite well. Less than half of one percent of bats contract rabies, and unlike most mammals, even when rabid, bats rarely become aggressive.

The Gray and Indiana bats are endangered in Alabama. These bats are receiving Federal protection at the present time. Under special concern are the Southeastern, the Bigearred, and the Free-Tailed bats; these species are currently receiving no state or Federal protection.

These sophisticated animals are disappearing rapidly, victims of thoughtless human persecution. They are among the world's most beneficial yet vulnerable mammals. Several species are already extinct, and many more may soon become extinct without better human understanding.

The biographical information provided on Dr. Merlin Tuttle should be shared with students. The background information provided on bats should be discussed with the students, also. Pictures of various types of bats should be collected to share with students. (Photographs by Dr. Tuttle portray bats as gentle, not vicious, animals.)

Source: The Most Famous Bat In The World - Bat Booklet, Bacardi Imports, Inc., 1984. (In conjunction with Bat Conservation International)

Materials

- File box, index
- Biographical Data: MERLINE TUTTLE
- Books with pictures of bats
- Socks, black or brown
- Cardboard
- Paper, construction
- Scissors
- Glue
- Paper
- Pencil

Procedures

1. Present pictures of various types of bats. Discuss unique features of each.
2. Discuss biographical information provided on Dr. Merlin Tuttle with the students. Provide the students with the background information on bats and encourage them to conduct further research.

OUTCOMES 90, 91, 92, 93, 94 (Continued)

Extensions

1. For a snack, provide samples of fruit pollinated by bats. (See background for a list of fruits.)
2. The best thing that can be done for bats is to spread good news about them! In addition, posting bat houses may provide homes for a few bats, as well as lower the local mosquito population. (Caves where bat colonies are hibernating or rearing young should be left alone.) To order a bat house write to Bat Conservation International, P. O. Box 162603, Austin, Texas 78716, Phone: (512) 327-9721.
3. Request that students bring old black or brown socks and make bat hand puppets with cardboard or construction paper wings.
4. Ask students to write a play about bats, showing how bats are helpful and why they deserve appreciation. Have students to present the play to other classes.

Background

Tides, waves, and currents are created and affected by various influences.

The biographical information provided on Alexander Humboldt should be shared with students. It will be necessary to place food coloring mixed with water into an ice tray and freeze before beginning the activity. An aquarium should be filled with water and placed where students can view it easily.

Materials

- File box, index
- Biographical Data: ALEXANDER HUMBOLDT
- Food coloring, any color
- Water
- Ice tray
- Aquarium
- Paper
- Pencils

Procedures

1. Discuss the biographical information provided on Alexander Humboldt.

OUTCOMES 90, 91, 92, 93, and 94 (Continued)

Procedures (Continued)

2. Emphasize that tides, waves, and currents are created and affected by various influences. Demonstrate the formation of water currents by the mixing of water of different temperatures. Place a colored ice cube in an aquarium filled with room temperature water.

3. Ask students to observe and draw pictures of the currents as indicated by the flow of color. Then compare this action to the formation of equatorial and polar currents in the ocean.

Source: California State Department of Education, Science Model Curriculum Guide, 1987.

Materials

- *Cry of the Kalahari*, Mark and Delia Owens, Houghton Mifflin Co., 1984.
- Pictures of African animals
- Paper
- Pencils
- Envelopes
- Stamps
- Biographical Data: MARK AND DELIA OWENS

Procedures

1. Present background information to the students concerning the work of Mark and Delia Owens.

2. Show pictures of Mark and Delia Owens and the animals of Africa. (Use *Cry of the Kalahari* by Mark and Delia Owens. Make the book available to students desiring to read the book.)

3. Discuss the need for the practice of conservation in the United States, Africa, and other parts of the world.

4. Request that students write letters to Mark and Delia Owens or become pen pals with a Zambian student in order to share conservation ideas.

Mark and Delia Owens
North Luangwa Conservation Project
P. O. Box 450148
Mpika, Zambia